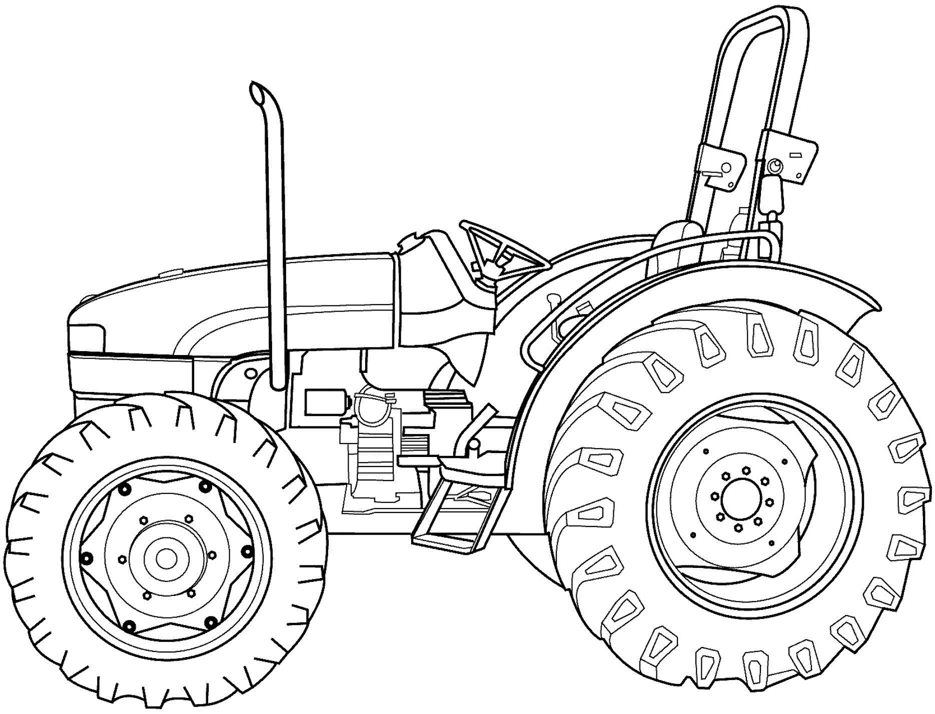
SERVICE MANUAL



Workmaster 45
Workmaster 55

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Foreword

This repair manual provides the technical information needed to properly service the New Holland WORKMASTER 45 and WORKMASTER 55 model tractors. Use this manual in conjunction with the operator’s manual for complete operation, adjustment, and maintenance information

On New Holland equipment, left and right are determined by standing behind the unit, looking in the direction of travel.

Foreword Ecology and the Environment

Soil, air, and water are vital factors of agriculture and life in general. When legislation does not yet rule the treatment of some of the substances which are required by advanced technology, common sense should govern the use and disposal of products of a chemical and petrochemical nature.

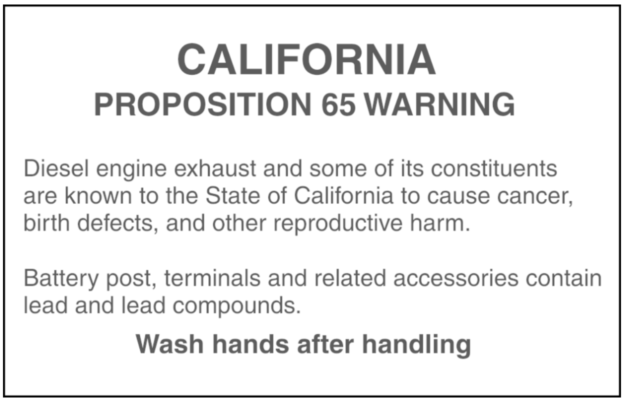
NOTICE: *The following are recommendations which may be of assistance:*

- Become acquainted with and ensure that you understand the relative legislation applicable to your country.
- Where no legislation exists, obtain information from suppliers of oils, filters, batteries, fuels, antifreeze, cleaning agents, etc., with regard to their effect on man and nature and how to safely store, use and dispose of these substances.
- Agricultural consultants will, in many cases, be able to help you as well.

HELPFUL HINTS

- Avoid filling tanks using cans or inappropriate pressurized fuel delivery systems which may cause considerable spillage.
- In general, avoid skin contact with all fuels, oils, acids, solvents, etc. Most of them contain substances which may be harmful to your health.
- Modern oils contain additives. Do not burn contaminated fuels and or waste oils in ordinary heating systems.
- Avoid spillage when draining off used engine coolant mixtures, engine, gearbox and hydraulic oils, brake fluids, etc. Do not mix drained brake fluids or fuels with lubricants. Store them safely until they can be disposed of in a proper way to comply with local legislation and available resources.
- Modern coolant mixtures, i.e. antifreeze and other additives, should be replaced every two years. They should not be allowed to get into the soil but should be collected and disposed of properly.
- Do not open the air-conditioning system yourself. It contains gases which should not be released into the atmosphere. Your NEW HOLLAND dealer or air conditioning specialist has a special extractor for this purpose and will have to recharge the system properly.
- Repair any leaks or defects in the engine cooling or hydraulic system immediately.
- Do not increase the pressure in a pressurized circuit as this may lead to a component failure.
- Protect hoses during welding as penetrating weld splatter may burn a hole or weaken them, allowing the loss of oils, coolant, etc.

Legal advice



CALIFORNIA

PROPOSITION 65 WARNING

Diesel engine exhaust and some of its constituents are known to the State of California to cause cancer, birth defects, and other reproductive harm.

Battery post, terminals and related accessories contain lead and lead compounds.

Wash hands after handling

BT09A213 1

International symbol

As a guide to the operation of the machine, various universal symbols have been utilized on the instruments, controls, switches, and fuse box. The symbols are shown below with an indication of their meaning.

Thermostart starting aid
Alternator charge
Fuel level
Automatic Fuel shut-off
Engine speed (rev/min x 100)
Hours recorded
Engine oil pressure
Engine coolant temperature
Coolant level
Tractor lights
Headlamp main beam
Headlamp dipped beam
Work lamps
Stop lamps
Horn

Radio
KAM Keep alive memory
Turn signals
Turn signals -one trailer
Turn signals -two trailers
Front windscreen wash/wipe
Rear windscreen wash/wipe
Heater temperature control
Heater fan
Air conditioner
Air filter blocked
Parking brake
Brake fluid level
Trailer brake
Roof beacon
Warning ! Corrosive substance

PTO
N Transmission in neutral
Creeper gears
Slow or low setting
Fast or high setting
Ground speed
Differential lock
Rear axle oil temperature
Transmission oil pressure
FWD engaged
FWD disengaged
Warning!
Hazard warning lights
Variable control
Pressurised! Open carefully

Position Control
Draft Control
Accessory socket
Implement socket
%age slip
Hitch raise (rear)
Hitch lower (rear)
Hitch height limit (rear)
Hitch height limit (front)
Hitch disabled
Hydraulic and transmission filters
Remote valve extend
Remote valve retract
Remote valve float
Malfunction! See Operator’s Manual
Malfunction! (alternative symbol)

Safety rules

PRECAUTIONARY STATEMENTS

Personal Safety

Throughout this manual and on machine signs, you will find precautionary statements ("DANGER", "WARNING", and "CAUTION") followed by specific instructions. These precautions are intended for the personal safety of you and those working with you. Please take the time to read them.

⚠ DANGER ⚠

This word "DANGER" indicates an immediate hazardous situation that, if not avoided, will result in death or serious injury. The color associated with Danger is RED.

M1169

⚠ WARNING ⚠

This word "WARNING" indicates a potentially hazardous situation that, if not avoided, could result in death or serious injury. The color associated with Warning is ORANGE.

M1170

⚠ CAUTION ⚠

This word "CAUTION" indicates a potentially hazardous situation that, if not avoided, may result in minor or moderate injury. It may also be used to alert against unsafe practices. The color associated with Caution is YELLOW .

M1171

FAILURE TO FOLLOW THE "DANGER", "WARNING", AND "CAUTION" INSTRUCTIONS MAY RESULT IN SERIOUS BODILY INJURY OR DEATH.

Machine Safety

The precautionary statement ("IMPORTANT") is followed by specific instructions. This statement is intended for machine safety.

NOTICE: *The word "IMPORTANT" is used to inform the reader of something they need to know to prevent minor machine damage if a certain procedure is not followed.*

Information

NOTE: *Instructions used to identify and present supplementary information.*

LEGAL OBLIGATIONS

This machine may be equipped with special guarding or other devices in compliance with local legislation. Some of these require active use by the operator. Therefore, check local legislation on the usage of this machine.

ACCIDENT PREVENTION

Most accidents or injuries that occur in workshops are the result of a non compliance to simple and fundamental safety regulations. For this reason, IN MOST CASES THESE ACCIDENTS CAN BE AVOIDED by foreseeing possible causes and consequently acting with the necessary caution and care.

Accidents may occur with all types of machines, regardless of how well the machine in question was designed and built.

A careful and informed service technician is the best guarantee against accidents.

Decisive awareness of the most basic safety rule is normally sufficient to avoid many serious accident.

⚠ DANGER ⚠

Shut down the machine, remove key, be sure all moving parts have stopped and all pressure in the systems is relieved before cleaning, adjusting or lubricating the equipment. Failure to comply will result in death or serious injury.

M871

SAFETY REQUIREMENTS FOR FLUID POWER SYSTEMS AND COMPONENTS - HYDRAULICS (EUROPEAN STANDARD PR EM 982)

Flexible hose assemblies must not be constructed from hoses which have been previously used as part of a hose assembly.
Do not weld hydraulic piping.
When flexible hoses or piping are damaged, replace them immediately.
It is forbidden to modify a hydraulic accumulator by machining, welding or any other means.
Before removing hydraulic accumulators for servicing, the liquid pressure in the accumulators must be reduced to zero.
Pressure check on hydraulic accumulators shall be carried out by method recommended by the accumulator manufacturer.
Care must be taken not to exceed the maximum allowable pressure of the accumulator. After any check or adjustment there must be no leakage of gas.

SAFETY RULES

A careful operator is the best operator. Most accidents can be avoided by observing certain precautions. To help prevent accidents, read and take the following precautions before operating this tractor. Equipment should be operated only by those who are responsible and instructed to do so.

THE TRACTOR

1. Read the Operator's Manual carefully before using the tractor. Lack of operating knowledge can lead to accidents.
2. Use an approved roll bar and seat belt for safe operation. Overturning a tractor without a roll bar can result in death or injury. If your tractor is not equipped with a roll bar and seat belt, see your NEW HOLLAND Dealer.
3. Always use the seat belt. The only instance when the seat belt should not be used is if the roll bar has been removed from the tractor or folding ROPS is in down position.
4. If a front end loader is to be installed, always use a FOPS (Falling Object Protective Structure) canopy to avoid injury from falling objects.
5. Use the handholds and step plates when getting on and off the tractor to prevent falls. Keep steps and platform cleared of mud and debris.
6. Do not permit anyone but the operator to ride on the tractor. There is no safe place for extra riders.
7. Keep all safety decals clean of dirt and grime, and replace all missing, illegible, or damaged safety decals. See the list of decals in the Decal section of this manual.

SERVICING THE TRACTOR

1. The cooling system operates under pressure which is controlled by the radiator cap. It is dangerous to remove the cap while the system is hot. Always turn the cap slowly to the first stop and allow pressure to escape before removing the cap entirely.
2. Keep any type of open flame away from the tractor and do not smoke while refueling.Wait for the engine to cool before refueling.
3. Keep the tractor and equipment, particularly brakes and steering, maintained in a reliable and satisfactory condition to ensure your safety and comply with legal requirements.
4. Keep open flame or cold weather starting aids away from the battery to prevent fires or explosions. Use jumper cables according to instructions to prevent sparks which could cause explosion.
5. Stop the engine before performing any service on the tractor.

6. Escaping hydraulic/diesel fluid under pressure can penetrate the skin causing serious injury. If fluid is injected into the skin, obtain medical attention immediately or gangrene may result.
   - DO NOT use your hand to check for leaks.
   - Use a piece of cardboard or paper to search for leaks.
   - Stop the engine and relieve pressure before connecting or disconnecting lines.
   - Tighten all connections before starting the engine or pressurizing lines.
7. Do not modify or permit anyone else to modify or alter this tractor or any of its components or functions without first consulting a NEW HOLLAND Dealer.
8. The fuel oil in the injection system is under high pressure and can penetrate the skin. Unqualified persons should not remove or attempt to adjust a pump, injector, nozzle, or any other part of the fuel injection system. Failure to follow these instructions can result in serious injury.
9. Continuous long-term contact with used engine oil may cause skin cancer. Avoid prolonged contact with used engine oil.Wash skin promptly with soap and water.
10. Some components of your tractor, such as gaskets and friction surfaces (brake linings, clutch linings, etc.) may contain asbestos. Breathing asbestos dust is dangerous to your health. You are advised to have any maintenance or repair on such components carried out by an authorized NEW HOLLAND Dealer. However, if service operations are to be undertaken on parts that contain asbestos, the essential precautions listed below must be observed:
    - Work out of doors or in a well ventilated area.
    - Dust found on the tractor or produced during work on the tractor should be removed by extraction, not by blowing.
    - Dust waste should be dampened, placed in a sealed container, and marked to ensure safe disposal.
    - If any cutting, drilling, etc. is attempted on materials containing asbestos, the item should be dampened and only hand tools or low speed power tools used.

OPERATING THE TRACTOR

1. Before starting the tractor, apply the parking brake, place the PTO lever in the ’OFF’ position, the lift control lever in the down position, the remote control valve levers in the neutral position, and the transmission in neutral.
2. Always sit in the tractor seat when starting the engine or operating controls. Do not start the engine or operate controls while standing beside the tractor.
3. Do not bypass the neutral start switches. Consult your NEW HOLLAND Dealer if your neutral start controls malfunction. Use jumper cables only in the recommended manner. Improper use can result in tractor runaway.
4. Avoid accidental contact with the gear shift lever while the engine is running, as this can cause unexpected tractor movement.
5. Before getting off the tractor, disengage the PTO, turn the engine off, and apply the parking brake. Never get off the tractor while it is in motion.
6. Do not park the tractor on a steep incline.
7. Do not operate the tractor engine in an enclosed building without adequate ventilation. Exhaust fumes can cause death or illness.
8. If the power steering or engine ceases operating, stop the tractor immediately.
9. Pull only from the drawbar or the lower link drawbar in the down position. Use only a drawbar pin that locks in place. Pulling from the tractor rear axle or any point above the axle may cause the tractor to upset.
10. 1If the front end of the tractor tends to rise when heavy implements are attached to the three-point hitch, install front end or front wheel weights. Do not operate the tractor with a light front end.
11. Always set the hydraulic selector lever in position control when attaching or transporting equipment. Ensure hydraulic couplers are properly mounted and will disconnect safely in case of accidental detachment of implement
12. Do not leave equipment in the raised position.
13. Use the flasher/turn signal lights and SMV signs when traveling on public roads both day and night (unless prohibited by law).
14. When operating at night, adjust lights to prevent blinding oncoming drivers.

DRIVING THE TRACTOR

1. Watch where you are going, especially at row ends, on roads, around trees and low hanging obstacles.
2. To avoid upsets, drive the tractor with care and at a safe speed. Use extra caution when operating over rough ground, when crossing ditches or slopes, and when turning corners.
3. To provide two-wheel braking, lock tractor brake pedals together when transporting on roads.
4. Do not coast or free wheel down hills. Use the same gear when going downhill as is used when going uphill.
5. Any towed vehicle with a total weight exceeding that of the towing tractor should be equipped with brakes for safe operation.
6. If the tractor becomes stuck or the tires become frozen to the ground, back up the tractor to prevent upset.
7. Always check overhead clearance, especially when transporting the tractor.
8. When operating at night, adjust lights to prevent blinding oncoming drivers.

OPERATING THE PTO

1. When operating PTO driven equipment, shut off the engine and wait until the PTO stops before getting off the tractor and disconnecting the equipment.
2. Do not wear loose clothing when operating the power take-off or when near rotating equipment.
3. When operating stationary PTO driven equipment, always place all gear shift levers in neutral position.
4. To avoid injury, do not clean, adjust, unclog, or service PTO driven equipment when the tractor engine is running.
5. Ensure the PTO master shield is installed at all times. Always replace the PTO shield cap when the PTO is not in use.

DIESEL FUEL

1. UNDER NO CIRCUMSTANCES should gasoline, alcohol, or blended fuels be added to diesel fuel. These combinations can create an increased fire or explosive hazard. Such blends are more explosive than pure gasoline in a closed container such as a fuel tank. DO NOT USE THESE BLENDS.
2. Never remove the fuel cap or refuel with the engine running or hot.
3. Do not smoke while refueling or when standing near fuel.
4. Maintain control of the fuel filler pipe nozzle when filling the tank.
5. Do not fill the fuel tank to capacity. Allow room for expansion.
6. Wipe up spilled fuel immediately.
7. Always tighten the fuel tank cap securely.
8. If the original fuel tank cap is lost, replace it with a NEW HOLLAND approved cap. A non-approved, proprietary cap may not be safe.
9. Keep equipment clean and properly maintained.
10. Do not drive equipment near open fires.
11. Never use fuel for cleaning purposes.
12. Arrange fuel purchases so that winter grade fuels are not held over and used in the spring.

SAFETY FRAME (ROPS)

Your NEW HOLLAND tractor is equipped with a safety frame. It must be maintained in a serviceable condition. Be careful when driving through doorways or working in confined spaces with low headroom.

UNDER NO CIRCUMSTANCES should you:

- Modify, drill, or alter the safety frame in any way. Doing so may render you liable to legal prosecution.
- Attempt to straighten or weld any part of the main frame or retaining brackets which have suffered damage. Doing so may weaken the structure and endanger your safety.
- Secure any parts on the main frame or attach your safety frame with anything other than the special high tensile bolts and nuts specified.
- Attach chains or ropes to the main frame for pulling purposes.
- Take unnecessary risks even though your safety frame affords you the maximum protection possible.

Basic instructions Hardware

General

Your tractor has been built using metric hardware.

NOTE: *Be sure to use the hardware specified when using tapped holes, as trying to install a metric bolt in an inch thread, or an inch bolt in a metric thread, will damage the thread.*

Certain hardware must be tightened to specific torque specifications. If specific torque specifications are not noted, tighten the hardware to the standard torque chart specification listed in this manual.

Plating

Hardware used on NEW HOLLAND balers is plated with zinc chromate (gold color). Gold colored hardware has different torquing requirements from unplated or zinc plated (silver color) hardware because of the difference in the coefficient of friction of the plating material. The torque charts in this manual list the correct specifications for gold, silver, and unplated bolts.

Nut Tightening

Whenever possible, the nut should be tightened, not the head of the bolt. When tightening using the bolt head, the clamp load can be lost because some of the torque applied twists the bolt instead of tensioning (stretching) it. The tension on the bolt is what holds the joint together.

Approximately 90% of the torque applied during assembly goes to overcoming friction between the parts. The other 10% is used to tension (stretch) the bolt. After assembly, the frictional forces disappear, which is the basis for the saying ’If it does not fail during assembly, it will not fail in service.’ The bolt may later fail due to other factors, but not from being over tightened.

Locknuts

Most locknuts are coated with a special lubricant that is dry to the touch. Anytime a locknut is used, a lower than normal torque is required. Refer to the torque charts in this manual for specific values.

Jam Nuts

When using a jam nut to lock a regular nut, the jam nut should be installed first and tightened to one half the recommended torque, then held in place while installing a regular nut to the recommended torque.

Thread Lubrication

The addition of antiseize compound, Molykote, oil, graphite, or any other lubricant to a bolt decreases the friction between it and a nut. This makes it necessary to reduce the recommended torque to prevent over tensioning of the bolt. When using the torque charts in this manual, decrease the value by 20% whenever a lubricant is used.

Torque Specification Tables

Standard Bolt Hardware & Hydraulic Connector Torques, Specifications and Information

This specification establishes general torque values to be used in bolted joints for metric and inch hardware. This specification is assumed to apply unless another specification (standard or specified requirement) is indicated in the repair manual.

NOTE: These Standards do not include electrical or hydraulic components, they are referred to in their specific charts or tables.

INCH 'NON-FLANGED' HARDWARE AND LOCKNUTS {MINIMUM HARDWARE TIGHTENING TORQUES}

IN NEWTON-METERS (FOOT-POUNDS) FOR NORMAL ASSEMBLY APPLICATIONS								
	SAE GRADE 2		**SAE GRADE 5**		**SAE GRADE 8**		**LOCKNUTS**	
Nominal Size	Unplated or Plated Silver	Plated w/ZnCr Gold	Unplated or Plated Silver	Plated w/ZnCr Gold	Unplated or Plated Silver	Plated w/ZnCr Gold	Gr.B w/Gr5 Bolt	Gr.C w/Gr8 Bolt
1/4	6.2 (55)*	8.1 (72)*	9.7 (86)*	13 (112)*	14 (121)*	18 (157)*	8.5 (75)*	12.2 (109)*
5/16	13 (115)*	17 (149)*	20 (178)*	26 (229)*	28 (21)	37 (27)	17.5 (155)*	25 (220)*
3/8	23 (17)	30 (22)	35 (26)	46 (34)	50 (37)	65 (48)	31 (23)	44 (33)
7/16	37 (27)	47 (35)	57 (42)	73 (54)	80 (59)	104 (77)	50 (37)	71 (53)
1/2	57 (42)	73 (54)	87 (64)	113 (83)	123 (91)	159 (117)	76 (56)	108 (80)
9/16	81 (60)	104 (77)	125 (92)	163 (120)	176 (130)	229 (169)	111 (82)	156 (115)
5/8	112 (83)	145 (107)	174 (128)	224 (165)	244 (180)	316 (233)	153 (113)	215 (159)
3/4	198 (146)	256 (189)	306 (226)	397 (293)	432 (319)	560 (413)	271 (200)	383 (282)
7/8	193 (142)	248 (183)	495 (365)	641 (473)	698 (515)	904 (667)	437 (323)	617 (455)
1	289 (213)	373 (275)	742 (547)	960 (708)	1048 (773)	1356 (1000)	654 (483)	924 (681)

NOTE: Torque values shown with * are inch pounds.

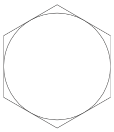
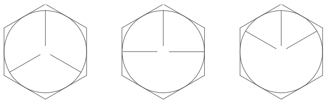
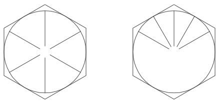
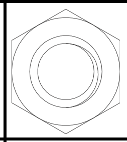
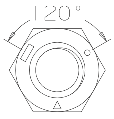
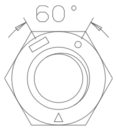
NOTICE: *Values shown on these charts are minimum hardware tightening torques unless otherwise stated.*

METRIC 'NON-FLANGED' HARDWARE AND LOCKNUTS {MINIMUM HARDWARE TIGHTENING TORQUES}

IN NEWTON-METERS (FOOT-POUNDS) FOR NORMAL ASSEMBLY APPLICATIONS							
	CLASS 5.8		**CLASS 8.8**		**CLASS 10.9**		**LOCK-NUTS**
Nominal Size	Unplated	Plated w/ZnCr	Unplated	Plated w/ZnCr	Unplated	Plated w/ZnCr	Cl.8 w/Cl8.8 Bolt
M4	1.7 (15)*	2.2 (19)*	2.6 (23)*	3.4 (30)*	3.7 (33)*	4.8 (42)*	2.3 (20)*
M6	5.8 (51)*	7.6 (67)*	8.9 (79)*	12 (102)*	13 (115)*	17 (150)*	7.8 (69)*
M8	14 (124)*	18 (159)*	22 (195)*	28 (21)	31 (23)	40 (30)	19 (169)*
M10	28 (21)	36 (27)	43 (32)	56 (41)	61 (45)	79 (58)	38 (28)
M12	49 (36)	63 (46)	75 (55)	97 (72)	107 (79)	138 (102)	66 (49)
M16	121 (89)	158 (117)	186 (137)	240 (177)	266 (196)	344 (254)	164 (121)
M20	237 (175)	307 (226)	375 (277)	485 (358)	519 (383)	671 (495)	330 (243)
M24	411 (303)	531 (392)	648 (478)	839 (619)	897 (662)	1160 (855)	572 (422)

NOTE: Torque values shown with * are inch pounds.

SAE HARDWARE IDENTIFICATION CHART

Grade	**1 or 2**	**5**	**8**
SAE Markings for Bolts and Cap Screws			
SAE Markings for Hex Nuts			
Grade A-B-C Locknuts	**A (No Notches)**	**B (Three Marks)**	**C (Six Marks)**

METRIC HARDWARE IDENTIFICATION CHART

Class	**5.8**	**8.8**	**10.9**
Hex Cap Screw and Carriage Bolts	Located on the face or flat, on the cap of the bolt	Located on the face or flat, on the cap of the bolt	Located on the face or flat, on the cap of the bolt
Hex Nuts and Locknuts	Located on the face or flat of the nut	Located on the face or flat of the nut	Located on the face or flat of the nut

Metric cap screws and nuts are identified by the grade number stamped on the head of the cap screw or on the surface of the nuts. U.S. customary cap screws are identified by radial lines stamped on the head of the cap screw.

DEFINITIONS:

1. Break-Away Torque - Torque measured in the direction of tightening, the moment before the bolt/nut starts to turn.
2. Clamping Force - Force equal to the tension in the fastener that clamps the parts together.
3. Stabilized Torque - Torque measured on a joint that has had a settling time after fastener installation, and the torque is measured in the direction of tightening, the moment after the bolt/nut begins to turn.
4. Proof Load - Safe test load for fasteners, approximately 10% below the yield load.
5. Torque - Force on the wrench handle times the handle length.
6. Torque and Turn - Bolting method utilizing a torque sufficient to close the joint, followed by rotation of a specific angle to obtain the desired bolt stretch.
7. Torque to Yield - Bolting method that tightens the joint until 0.2% yield is detected. Generally requires a computer monitored tightening tool.
8. Target Torque - Torque specified by engineering, generally nominal torque.
9. Ultimate Load - Load when bolt failure occurs.
10. Yield Load - Load when 0.2% deformation occurs.

NOTE: Fasteners should be replaced with the same or higher grade. If higher grade fasteners are used, these should only be tightened to the strength of the original. When replacing cap screws, always use a cap screw of the same measurement and strength as the cap screw being replaced.

NOTE: Make sure the fasteners threads are clean, and that thread engagement is started. This will prevent them from failing when being tightened. Assure that joints that utilize threaded fasteners are properly tightened, and that they remain tight during the period of their intended usage.

NOTE: Tighten plastic insert or crimped steel-type lock nuts to approximately 50 % of table torque, applied to the nut, not the bolt head. Tighten toothed or serrated type lock nuts to their full torque value.

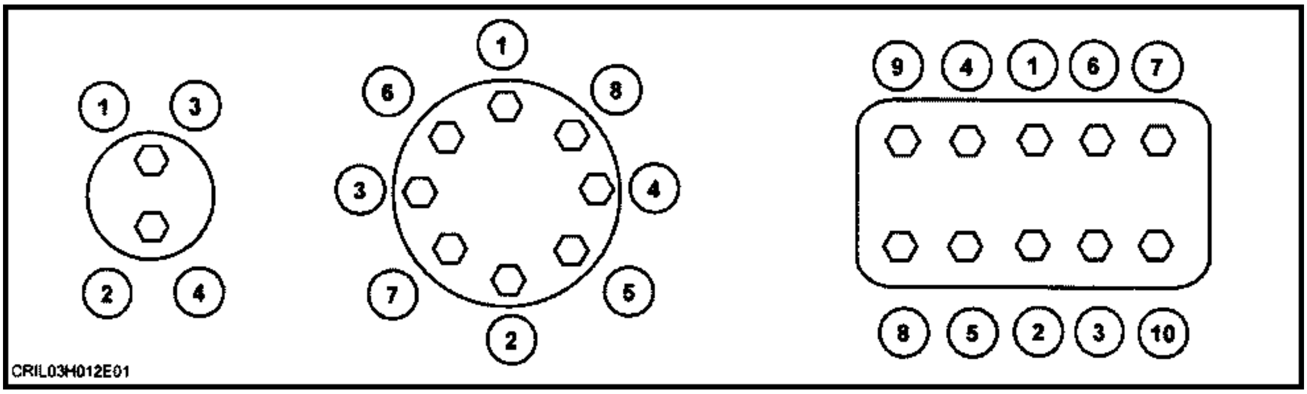
NOTE: Always use the torque values listed in the supplied charts in this section when values are not supplied in a procedure.

NOTE: DO NOT use these torque values when values are given in a specified procedure.

NOTE: Reuse of fasteners. Fasteners that have been tightened above yield point during assembly should not be reused after disassembly. They have been permanently deformed and the elastic range has been shifted closer to the ultimate tensile point.

NOTE: Torque and Turn is a recommended procedure for manufacturing and service when sophisticated tools are not available, especially for large diameter fasteners.

NOTE: Large diameter fasteners, unless specifically stated, should be tightened in sequence using the related torque chart below, at a low torque that is sufficient until the joint is closed. Each bolt is then rotated 90 degrees in sequence. Each bolt is then rotated another 90 degrees in sequence. The result is a clamp load above the yield point. This procedure results in a consistent clamp load. The fasteners should not be reused after disassembly.



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NOTE: Shown above is the suggested initial torque tightening sequences for general applications, tighten in sequence from item 1 through to the last item of hardware.

Hydraulic Hoses and Tubes

NOTE: Tightening the joint to the proper torque will keep it leak free, and prevent it from damaging the hose or fitting.

Always replace hoses and tubes with damaged cone ends or the end connections.
When installing a new hose, loosely connect each end and make sure the hose fits its desired location, without kinking or twisting, before tightening the connection. Tighten non-swivel end of hose first if applicable. Tighten the hose clamps enough to hold the hose without chafing but not so tight as to crush the ends.
Keep the hoses and tubes clear of moving parts and replace any hoses and fittings that have moved from their original positions over time. A hose with a chafed outer cover will allow moisture to get into the system. Concealed corrosion of the wire reinforcement will then occur along the hose length and result in hose failure.
Ballooning of the hose indicates internal leakage as the hose deteriorates. This condition can rapidly lead to hose failure.
Kinked, crushed, stretched or damaged hoses generally suffer internal structural damage that restricts fluid flow, reduces performance and ultimately causes the hose to fail.
Do not allow free moving, unsupported hoses or tubes to touch each other or related working surfaces. This causes chafing and reduces line life.

National Pipe Thread (NPT) Fittings

Before installing and tightening pipe fittings, clean the threads with a cleaning solvent or Loctite® brand cleaner. Apply the appropriate Loctite® brand sealant to all fittings including stainless steel, unless as otherwise stated. Generally Loctite® 567™ can be used for all fittings including stainless steel. Loctite® 565™ is used for most metal fittings. For high filtration/zero contamination systems use Loctite® 545™.

NPT PIPE FITTING TORQUE CHART

Thread Size	Torque (Maximum)
1/8" - 27	**13 Nm** (**10 lb ft**)
1/4" - 18	**16 Nm** (**12 lb ft**)
3/8" - 18	**22 Nm** (**16 lb ft**)
1/2" - 14	**41 Nm** (**30 lb ft**)
3/4" - 14	**54 Nm** (**40 lb ft**)

PIPE FITTING

Nom. SAE Dash Size	Thread Size	TFFT (Turns For Finger Tight)
-2	1/8 - 27	2.0 - 3.0
-4	1/4 - 18	2.0 - 3.0
-6	3/8 - 18	1.5 - 3.0
-8	1/2-14	2.0 - 3.0
-12	3/4 - 14	2.0 - 3.0
-16	1 - 11-1/2	1.5 - 2.5
-20	1-1/4 - 11-1/2	1.5 - 2.5
-24	1-1/2 - 11-1/2	1.5 - 2.5
-32	2 - 11-1/2	1.5 - 2.5

Apply sealant/lubricant to male pipe threads. The first two threads should be left uncovered to avoid system contamination. Screw pipe fitting into female pipe port to the finger tight position. Wrench tighten fitting to the appropriate turns from finger tight (TFFT) shown in table above, making sure the tube end of an elbow or tee fitting is aligned to receive incoming tube or hose fitting.

Installation of Adjustable Fittings in Straight Thread O Ring Bosses

1. Lubricate the O ring by coating it with light oil or petroleum jelly. Install the O ring in the groove adjacent to the metal backup washer which is assembled at the extreme end of the groove.
2. Install the fitting into the SAE straight thread boss until the metal backup washer contacts the face of the boss.
   NOTE: Do not over tighten and distort the metal backup washer.
3. Position the fitting by turning out (counter clockwise) up to a maximum of one turn. Holding the pad of the fitting with a wrench, tighten the locknut and washer against the face of the boss.

4. When hose ends or connectors are made of materials other than steel, different torque values may be required.

O RING BOSS END FITTING OR LOCK NUT

Nom. SAE Dash Size	Thread Size	Newton·meters	lb/in	lb/ft
-6	9/16 - 18	48 to 54	432 to 480	
-8	3/4 - 16	70 to 78	612 to 684	
-10	7/8 - 14	102 to 114		75 to 84
-12	1-1/16 - 12	142 to 160		105 to 117
-16	1-5/16 - 12	237 to 254		175 to 187

37 DEGREE FLARE FITTING (STEEL HYDRAULIC FITTINGS)

Nom. SAE Dash Size	Tube OD/Hose ID		Thread Size	Newton·meters	lb/in	lb/ft
-2			5/16 - 24	8 to 9	72 to 84	
-3			3/8 - 24	11 to 12	96 to 108	
-4	6.4 mm	1/4 inch	7/16 - 20	14 to 16	120 to 144	
-5	7.9 mm	5/16 inch	1/2 - 20	18 to 21	156 to 192	
-6	9.5 mm	3/8 inch	9/16 - 18	27 to 33	240 to 300	
-8	12.7 mm	1/2 inch	3/4 - 16	46 - 56	408 to 504	
-10	15.9 mm	5/8 inch	7/8 - 14	77 to 85	684 to 756	
-12	19.0 mm	3/4 inch	1-1/16 - 12	107 to 119		79 to 88
-14	22.2 mm	7/8 inch	1-3/16 -12	127 to 140		94 to 103
-16	25.4 mm	1.0 inch	1-5/16 - 12	131 to 156		97 to 117
-20	31.8 mm	1-1/4 inch	1-5/8 - 12	197 to 223		145 to 165
-24	38.1 mm	1-1/2 inch	1-7/8 - 12	312 to 338		230 to 250

37 DEGREE FITTINGS

TUBE NUTS FOR 37 DEGREE FLARED FITTINGS								O RING BOSS PLUGS ADJUSTABLE FITTING LOCKNUTS, SWIVEL JIC-37° SEATS			
				TORQUE				TORQUE			
Size	Tubing OD		Thread Size	Newton· Meters		Foot Pounds		Newton· Meters		Foot Pounds	
	mm	in.		Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.
4	6.4	1/4	7/16-20	12	16	9	12	8	14	6	10
5	7.9	5/16	1/2-20	16	20	12	15	14	20	10	15
6	9.5	3/8	9/16-18	29	33	21	24	20	27	15	20
8	12.7	1/2	3/4-16	47	54	35	40	34	41	25	30
10	15.9	5/8	7/8-14	72	79	53	53	47	54	35	40
12	19.1	3/4	1-1/16-12	104	111	77	82	81	95	60	70
14	22.2	7/8	1-3/16-12	122	136	90	100	95	109	70	80
16	25.4	1	1-5/16-12	149	163	110	120	108	122	80	90
20	31.8	1-1/4	1-5/8-12	190	204	140	150	129	158	95	115

These torques are not recommended for tubes of **12.7 mm** (**0.5 in**) OD and larger with wall thickness of **0.89 mm** (**0.035 in**) or less. The torque is specified for **0.89 mm** (**0.035 in**) wall tubes on each application individually. Before installing and torquing 37° flared fittings, clean the face of the flare and threads with a cleaning solvent or Loctite® brand cleaner, and apply hydraulic sealant Loctite® 569™ to the 37° flare and the threads. Install fitting, and torque to specified torque, loosen fitting and re-torque to specifications.

General specification

ENGINE	WORKMASTER 45	WORKMASTER 55
Type/Model	Diesel/N844L	Diesel/N844LT
Emission Level	Tier 3	Tier 3
Engine Gross Horsepower	**33.6 kW** (**45.0 Hp**)	**37.3 kW** (**50.0 Hp**)
PTO Horsepower	**29 kW** (**39 Hp**)	**35.5 kW** (**47.6 Hp**)
Cylinders	4	4
Bore	**84 mm** (**3.31 in**)	**84 mm** (**3.31 in**)
Stroke	**100 mm** (**3.94 in**)	**100 mm** (**3.94 in**)
Displacement	**2.2 l** (**135.2 in³**)	**2.2 l** (**135.2 in³**)
Compression Ratio	22.5:1	22.5:1
Firing Order	1-3-4-2	1-3-4-2
Aspiration	Natural	Turbocharged
Low Idle Speed	**1050 RPM** ± 50	**1100 RPM** ± 50
Maximum no-load speed:	**2900 - 2950 RPM**	**2900 - 2950 RPM**
Rated Speed	**2600 RPM**	**2800 RPM**
Tappet Clearance Intake/Exhaust (cold)	**0.2 mm** (**0.008 in**)	**0.2 mm** (**0.008 in**)
Crankcase Oil Capacity	**5.5 l** (**5.8 US qt**)	**7.0 l** (**7.4 US qt**)
CAPACITIES		
Fuel Tank	**51 l** (**13.5 US gal**)	**51 l** (**13.5 US gal**)
Cooling System	**8.5 l** (**9.0 US qt**)	**10.0 l** (**10.5 US qt**)
Engine Crankcase Oil Capacity	**5.5 l** (**5.8 US qt**)	**7.0 l** (**7.4 US qt**)
Rear Axle & Transmission	**25 l** (**6.6 US gal**)	**25 l** (**6.6 US gal**)
Front Axle (FWD)	**7.5 l** (**8.0 US qt**)	**7.5 l** (**8.0 US qt**)

COOLING SYSTEM	**WORKMASTER 45**	**WORKMASTER 55**
Type	Pressurized Liquid with Recirculating Bypass	Pressurized Liquid with Recirculating Bypass
Water Pump:		
Type	Centrifugal	Centrifugal
Drive	V-Belt	V-Belt
Belt Deflection	**10 - 15 mm** (**0.4375 - 0.5625 in**) when **9 - 11 kg** (**20 - 25 lb**) thumb pressure is applied midway between belt pulleys	**10 - 15 mm** (**0.4375 - 0.5625 in**) when **9 - 11 kg** (**20 - 25 lb**) thumb pressure is applied midway between belt pulleys
Fan Diameter	**410 mm** (**16.1 in**)	**410 mm** (**16.1 in**)
Number of Fan Blades	6	8
Thermostat:		
Start to Open	**71 °C** (**160 °F**)	**71 °C** (**160 °F**)
Fully Open	**82 °C** (**180 °F**)	**82 °C** (**180 °F**))
Radiator Cap	**90 kPa** (**13 psi**)	**90 kPa** (**13 psi**)
Antifreeze	Ethylene Glycol	Ethylene Glycol
System Capacity	**8.5 l** (**9.0 US qt**)	**8.5 l** (**9.0 US qt**)
ELECTRICAL SYSTEM		
Main System Protection	Fusible Link (**20 A**)	Fusible Link (**20 A**)
Number Fuses for Circuit Protection	6	6
Alternator	**12 V**, **40 A**	**12 V**, **40 A**
Battery Type	**12 V**, w/ negative ground, 600-850 cca BCI group 49	**12 V**, w/ negative ground, 600-850 cca BCI group 49
Starter Motor - Type	Solenoid operated	Solenoid operated
Starter KW(HP) Rating	**2.0 kW** (**2.7 Hp**)	**2.0 kW** (**2.7 Hp**)
Bulb Rating and Type		
Head Light	35/ **35 W**	35/ **35 W**
Turn Signal	**27 W**/#1156	**27 W**/#1156
Tail Light	**8.5 W**/#1157	**8.5 W**/#1157
FUEL SYSTEM		
Fuel Type	Diesel	Diesel
Type of Fuel to Use if above **5 °C** (**40 °F**)	No. 2-Diesel, Cetane Rating: Minimum 45	No. 2-Diesel, Cetane Rating: Minimum 45
Type of Fuel to Use if below **5 °C** (**40 °F**)	No. 1-Diesel, Cetane Rating: Minimum 45	No. 1-Diesel, Cetane Rating: Minimum 45
Injection Pump:		
Type	In-Line CTD	In-Line CTD
Timing	**19 - 20.5 °** BTDC	**17.5 - 19 °** BTDC

CLUTCH	**WORKMASTER 45**	**WORKMASTER 55**
Type	Double Disc/Dry	Double Disc/Dry
(Transmission) Clutch Disc Diameter	**280 mm** (**11 in**)	**280 mm** (**11 in**)
(PTO) Clutch Disc Diameter	**280 mm** (**11 in**)	**280 mm** (**11 in**)
Pedal Free-Travel	**35 - 40 mm** (**1.38 - 1.57 in**)	**35 - 40 mm** (**1.38 - 1.57 in**)
BRAKES		
Type	Wet Disc	Wet Disc
Number of Discs per side	2	2
Brake Disc Diameter	**165 mm** (**6.5 in**)	**165 mm** (**6.5 in**)
Pedal Free Travel	**50 - 55 mm** (**1.96 - 2.16 in**)	**50 - 55 mm** (**1.96 - 2.16 in**)
STEERING		
Type	Power	Power
Pump Flow	**20.1 l/min** (**5.3 US gpm**)	**20.1 l/min** (**5.3 US gpm**)
Maximum Hydraulic Steering Pressure	**13700 kPa** (**1987 psi**)	**13700 kPa** (**1987 psi**)
Turns Lock-to-Lock:		
2WD	4	4.5
4WD	3.75	3.75
Turning Radius		
Without Brakes (2WD)	**3600 mm** (**142 in**))	**3350 mm** (**132 in**))
With Brakes (2WD)	**3100 mm** (**122 in**))	**3000 mm** (**118 in**))
Without Brakes (4WD)	**4475 mm** (**176 in**))	**4475 mm** (**176 in**))
With Brakes (4WD)	**3950 mm** (**155 in**))	**3950 mm** (**155 in**))
Maximum Steering Angle:		
2WD	**46 °**	**52 °**
4WD	**37 °** inner **30 °** outer	**37 °** inner **30 °** outer
POWER TAKE-OFF		
Type	Independent	Independent
Clutch Disc Size	**280 mm** (**11 in**)	**280 mm** (**11 in**)
Clutch Material	Organic	Organic
Control	Hand Lever, Mechanical	Hand Lever, Mechanical
Shaft:		
Rear PTO	**35 mm** (**1.375 in**)	**35 mm** (**1.375 in**)
Number of Splines	6	6
PTO Shaft Rotation	Clockwise (Viewed from rear)	Clockwise (Viewed from rear)
Engine Speed for 540 rpm rear PTO Operation	**2576 RPM**	**2576 RPM**
PTO Horsepower	**29 kW** (**39 Hp**)	**35.5 kW** (**47.6 Hp**)

HYDRAULIC LIFT SYSTEM	WORKMASTER 45	WORKMASTER 55
Type	Open Center	Open Center
Pump Type	Gear, engine driven	Gear, engine driven
Pump Capacity	**44 l/min** (**11.6 US gpm**)	**44 l/min** (**11.6 US gpm**)
System Relief Valve Setting	**17500 kPa** (**2538 psi**)	**17500 kPa** (**2538 psi**)
Number of Rear Remotes	2 (optional)	2 (optional)
Number of Front Remotes	2 (optional)	2 (optional)
Draft Control	Not Available	Standard Equipment
Three-Point Linkage		
Category Type	II	II
Lift capacity at ball ends	**1060 kg** (**2337 lb**)	**1430 kg** (**3153 lb**)
Lift capacity **610 mm** behind ball ends	**830 kg** (**1830 lb**)	**1170 kg** (**2579 lb**)
Clutch System		
Type	Double Disc/Dry	Double Disc/Dry
(Transmission) Clutch Disc Diameter	**280 mm** (**11 in**)	**280 mm** (**11 in**)
(PTO) Clutch Disc Diameter	**280 mm** (**11 in**)	**280 mm** (**11 in**)
Pedal Free Travel	**35 - 40 mm** (**1.38 - 1.57 in**)	**35 - 40 mm** (**1.38 - 1.57 in**)

Transmission Speeds (8X8) - Forward		**WORKMASTER 45**	**WORKMASTER 55**
Main Gear	Range Gear	(**2700 RPM** Engine Speed with 13.6 x 28 Rear Tires)	(**2700 RPM** Engine Speed with 14.9 x 28 Rear Tires)
1st	Low	**2.79 km/h** (**1.73 mph**)	**2.80 km/h** (**1.74 mph**)
2nd		**4.20 km/h** (**2.60 mph**)	**4.21 km/h** (**2.61 mph**)
3rd		**6.20 km/h** (**3.85 mph**)	**6.22 km/h** (**3.86 mph**)
4th		**8.52 km/h** (**5.30 mph**)	**8.56 km/h** (**5.32 mph**)
1st	High	**10.11 km/h** (**6.28 mph**)	**10.96 km/h** (**6.81 mph**)
2nd		**15.23 km/h** (**9.46 mph**)	**16.51 km/h** (**10.25 mph**)
3rd		**22.48 km/h** (**14.00 mph**)	**24.37 km/h** (**15.14 mph**)
4th		**30.92 km/h** (**19.21 mph**)	**33.53 km/h** (**20.83 mph**)

Transmission Speeds (8X8) - Reverse		**WORKMASTER 45**	**WORKMASTER 55**
Main Gear	Range Gear	(**2700 RPM** Engine Speed with 13.6 x 28 Rear Tires)	(**2700 RPM** Engine Speed with 14.9 x 28 Rear Tires)
1st	Low	**2.94 km/h** (**1.83 mph**)	**2.96 km/h** (**1.84 mph**)
2nd		**4.43 km/h** (**2.75 mph**)	**4.45 km/h** (**2.76 mph**)
3rd		**6.55 km/h** (**4.07 mph**)	**6.58 km/h** (**4.10 mph**)
4th		**9.01 km/h** (**5.60 mph**)	**9.04 km/h** (**5.62 mph**)
1st	High	**10.68 km/h** (**6.64 mph**)	**11.58 km/h** (**7.20 mph**)
2nd		**16.09 km/h** (**10.00 mph**)	**17.44 km/h** (**10.84 mph**)
3rd		**23.75 km/h** (**14.76 mph**)	**25.75 km/h** (**16.00 mph**)
4th		**32.68 km/h** (**20.31 mph**)	**35.43 km/h** (**22.01 mph**)

TIRES	**WORKMASTER 45**	**WORKMASTER 55**
FRONT:		
Agricultural:		
2WD	6.00 x 16 F2, 6 Ply	7.50 x 16 F2, 6 Ply
4WD	8.3 x 24 R1, 6 Ply	9.5 x 24, R1, 6 Ply
REAR:		
Agricultural		
2WD and 4WD	13.6 x 28, R1, 6Ply	14.9 x 28, R1, 6Ply
WHEEL BOLT TORQUES		
Front Wheel - Disc-to-Hub:	**123 N·m** (**91 lb ft**)	**123 N·m** (**91 lb ft**)
Rear Wheel - Disc-to Hub	**192 N·m** (**142 lb ft**)	**192 N·m** (**142 lb ft**)

General specification - Biodiesel Fuels

Fatty Acid Methyl Ester Biodiesel (Biodiesel Fuel) consists of a family of fuels derived from vegetable oils treated with methyl esters.

NOTICE: *Biodiesel Fuel blends are approved for your engine only if they comply with* ***EN14214*** *Specification Standards or* ***ASTM D6751****.*

NOTICE: *It is imperative that you check which blend is approved for your engine with your NEW HOLLAND dealer. Be aware that the use of Biodiesel Fuel that does not comply with the Standards mentioned above could lead to severe damage to the engine and fuel system of your machine. The use of fuels that are not approved may void NEW HOLLAND Warranty coverage.*

Biodiesel Fuel Usage Conditions

NOTICE: *The Biodiesel Fuel must meet the fuel Specification mentioned above.*

Biodiesel Fuel must be purchased from a trusted supplier that understands the product and maintains good fuel quality. Biodiesel Fuel must be pre-blended by the supplier. Mixing Biodiesel Fuels on-site can result incorrect mixture that can lead to problems with both engine and fuel system.

Engine performance is affected by the use of Biodiesel Fuel. There may be up to **12 %** reduction in power or torque depending on the blend used.

NOTICE: *DO NOT modify the engine and/or injection pump settings to recover the reduced performance.*

The reduced power must be accepted if using any Biodiesel Fuel blend.

Some modification may be required to allow your engine to run Biodiesel Fuel. Consult you dealer for complete information on these modifications.

Biodiesel Fuel has a higher cloud point than Diesel Fuel.

NOTICE: *The use of high Biodiesel Fuel blends are not recommended in cold weather conditions.*

With Biodiesel Fuels, it may be necessary to change the engine oil, engine oil filter and fuel filter elements more frequently than with Diesel Fuels. Biodiesel Fuel can remove rust and particles from the inside of on-site fuel storage tanks that would normally adhere to the sides of the tank. Like particle deposits that commonly occur with Diesel Fuel, these particles can become trapped by the machine fuel filters, causing blockage and shortening filter life. In cold weather, this is more likely to happen. Consult your NEW HOLLAND dealer for information on cold weather operation and proper maintenance intervals when using any Biodiesel Fuel blend.

When handling Biodiesel Fuel, care must be taken not to allow water into the fuel supply. Biodiesel Fuel will actually attract moisture from the atmosphere.

Fuel tanks must be kept as full as possible to limit the amount of air and water vapors in them. It may be necessary to drain the fuel filter water tap more frequently.

Potential oxidation and stability could be a problem with the fuel stored in the machine.

NOTICE: *Machines must not be stored for more than three months with Biodiesel Fuel blends in the fuel system.*

If long storage periods are necessary, the engine must run on Diesel Fuel for 20 hours to flush the Biodiesel Fuel out of the engine fuel system prior to storage.

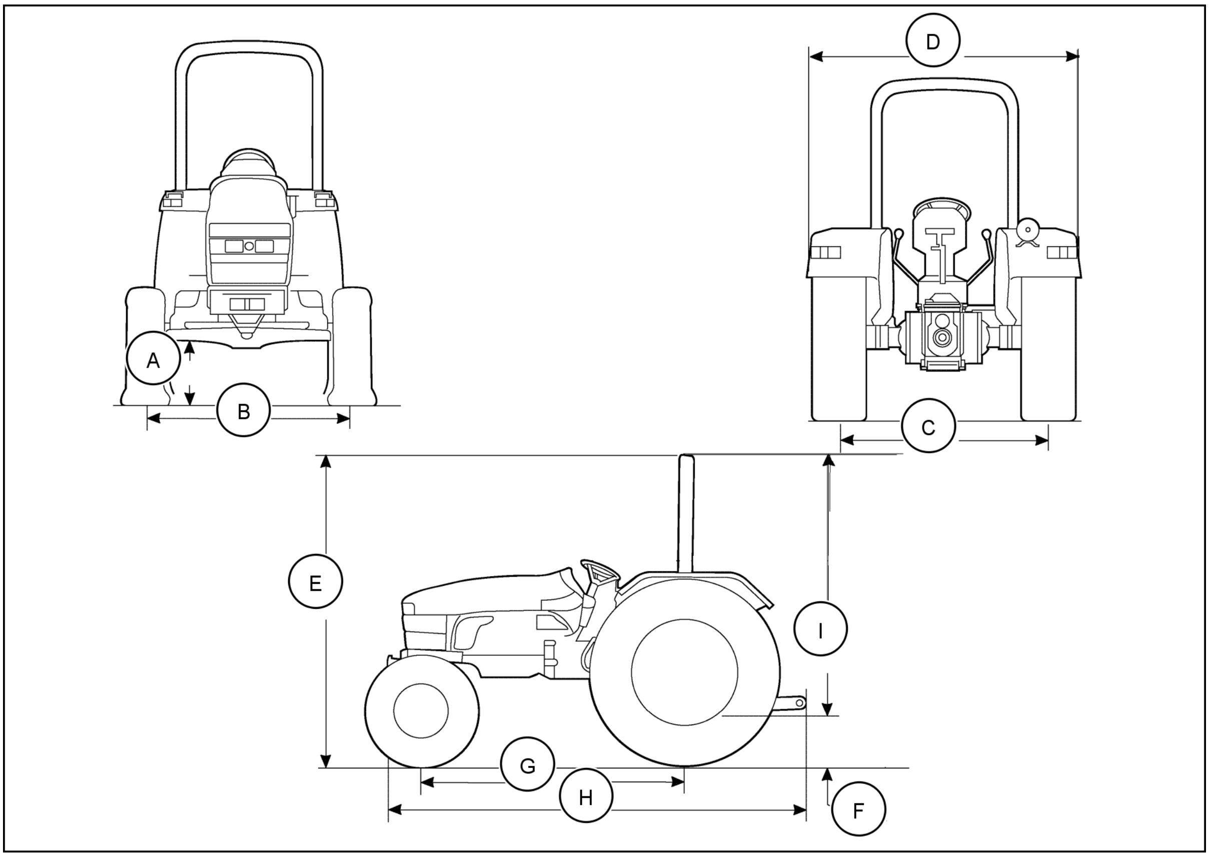
NOTICE: *Biodiesel Fuel must not be stored in on-site storage tanks for more than three months.*

Any spillage of Biodiesel Fuel must be cleaned up immediately before it can cause damage to the environment and the paint finish of the machine.

Before using Biodiesel Fuel blends you should consult with your dealer to receive full information about the approved blend for your machine and any detailed conditions of its usage.

NOTICE: *Be aware that not fulfilling the requirements and conditions of Biodiesel Fuel usage will void your machine's NEW HOLLAND Warranty coverage.*

Dimension



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NOTE: *The following dimensions are based on standard tractors fitted with tire sizes as shown. Allowance must be given for tires of larger or smaller dimensions.*

	WORKMASTER 45	WORKMASTER 55
Front	6.00 x 16 2WD/8.3x24 4WD	7.50 x 16 2WD/9.5x24 4WD
Rear	13.6 x 28	14.9 x 28
(A) Ground clearance under center of front axle	NA 2WD	NA 2WD
	355 mm (**14 in**) 4WD	**380 mm** (**15 in**) 4WD
(B) Front wheel tread setting (Std.)	**1277 mm** (**50.27 in**) 2WD	**1410 mm** (**55.51 in**) 2WD
	1330 mm (**52.36 in**) 4WD	**1330 mm** (**52.36 in**) 4WD
(C) Rear wheel tread setting (Std.)	**1426 mm** (**56.14 in**) 2WD	**1426 mm** (**56.14 in**) 2WD
	1340 mm (**52.75 in**) 4WD	**1350 mm** (**53.15 in**) 4WD
(D) Overall width	**1680 mm** (**66.14 in**) 2WD	**1680 mm** (**66.14 in**) 2WD
	1680 mm (**66.14 in**) 4WD	**1680 mm** (**66.14 in**) 4WD
(E) Height to top of ROPS	**2385 mm** (**94.0 in**) 2WD	**2435 mm** (**99.0 in**) 2WD
	2385 mm (**94.0 in**) 4WD	**2435 mm** (**99.0 in**) 4WD
(F) Ground clearance under drawbar	**336 mm** (**13.2 in**) 2WD	**386 mm** (**15.2 in**) 2WD
	356 mm (**14.0 in**) 4WD	**386 mm** (**15.2 in**) 4WD
(G) Wheel base	**1975 mm** (**77.75 in**) 2WD	**1970 mm** (**77.56 in**) 2WD
	1960 mm (**77.16 in**) 4WD	**1960 mm** (**77.16 in**) 4WD
(H) Overall Length	**3331 mm** (**131.14 in**) 2WD	**3331 mm** (**131.14 in**) 2WD
	3390 mm (**133.46 in**) 4WD	**3390 mm** (**133.46 in**) 4WD
(I) Rear axle to top of ROPS	**1795 mm** (**70.67 in**) 2WD	**1795 mm** (**70.67 in**) 2WD
	1795 mm (**70.67 in**) 4WD	**1795 mm** (**70.67 in**) 4WD

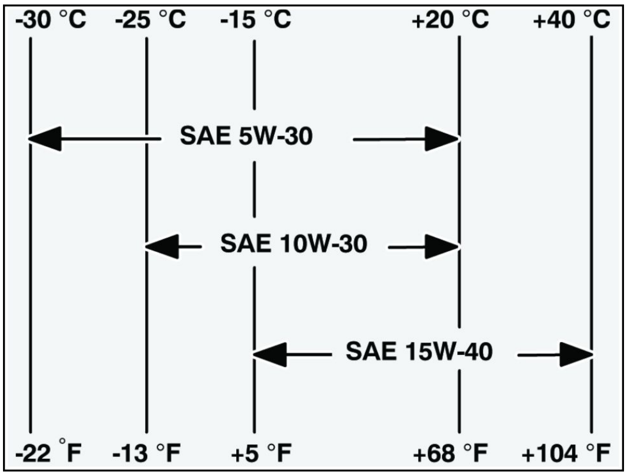
Tractor Total Weight

Model	2WD	4WD
WORKMASTER 45	**1600 kg** (**3527 lb**)	**1740 kg** (**3836 lb**)
WORKMASTER 55	**1710 kg** (**3770 lb**)	**1854 kg** (**4078 lb**)

Engine Oil

The correct engine oil viscosity grade is dependent upon ambient temperature. Refer to the chart on the right when selecting oil for your tractor engine.

***NOTE:** In areas where prolonged periods of extreme temperatures are encountered, local lubricant practices are acceptable; such as the use of SAE 5W30 in extreme low temperatures or SAE50 in extreme high temperatures.*



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Sulfur in Fuel

The engine oil change period is shown in Section 3. However, locally available fuel may have a high sulphur content, in which case the engine oil change period should be adjusted as follows:

Sulfur Content %	
Below 0.5	Normal
0.5-1.0	Half the normal
above 1.0	One quarter normal

***NOTICE:** The use of fuel with a sulfur content above **1.3 %** is not recommended.*

Consumables

Recommended Fluids and Application	**NEW HOLLAND Specification**	**International Specification**	**Approximate Quantities**	
			WORKMASTER 45	**WORKMASTER 55**
Engine Oil:				
NEW HOLLAND AMBRA SUPER GOLD HSP ENGINE OIL	NH 324G 10W-30	API CF4	**5.5 l (5.8 US qt)**	**7.05 l (7.4 US qt)**
Transmission/Rear Axle Oil				
NEW HOLLAND AMBRA MULTI G 134	NH 410B	API GL4, ISO 32/46	**25.0 l (6.6 US gal)**	**25.0 l (6.6 US gal)**
Front Axle Differential/Final Reduction Gear Case				
NEW HOLLAND AMBRA MULTI G 134	NH 410B	API GL4, ISO 32/46	**7.5 l (8.0 US qt)**	**7.5 l (8.0 US qt)**
Grease Fittings/Bearings				
AMBRA GR9	NH 710A	NLGI #2	As required	As required
Steering Oil (Hydraulic)				
NEW HOLLAND AMBRA MULTI G 134	NH 410B	API GL4, ISO 32/46	**2.0 l (2.1 US qt)**	**2.0 l (2.1 US qt)**
Engine Radiator Coolant				
System Capacity			**8.5 l (9.0 US qt)**	**10.0 l (10.5 US qt)**
*Water			**50 %**	**50 %**
Ethylene Glycol	NH 900A		**50 %**	**50 %**

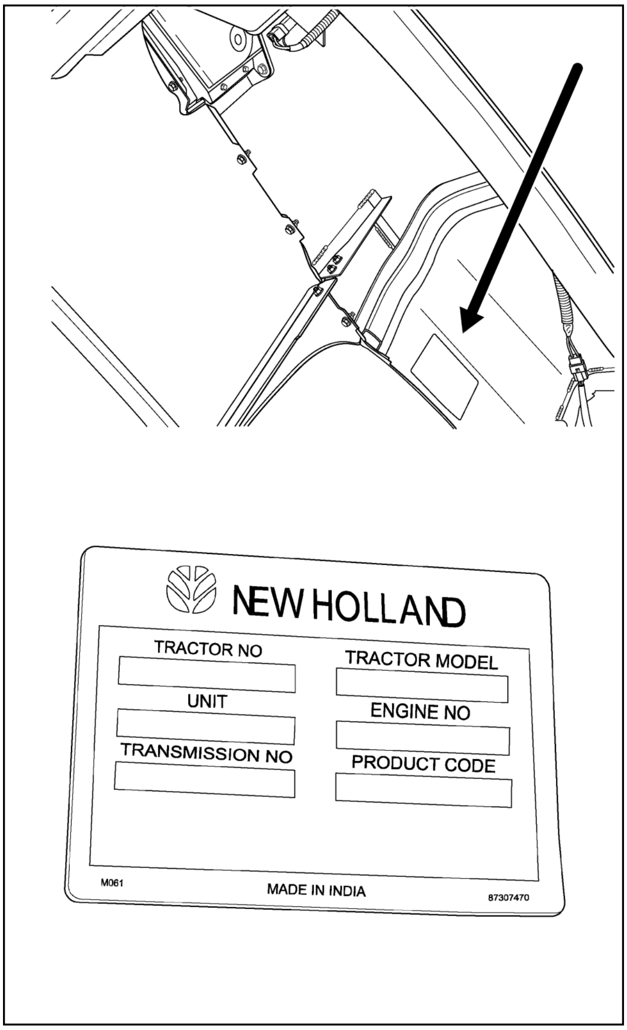
NOTE: **See Operator's manual, Section 4, page 6 and page 27, for further details before topping off or changing the engine coolant.*

Product identification

Tractor Identification Decal

(Underside of Hood)

The first line represents tractor serial number and model while the second line represents unit code and engine serial number followed by transmission serial number. Record the information in Figure **1** for quick reference.



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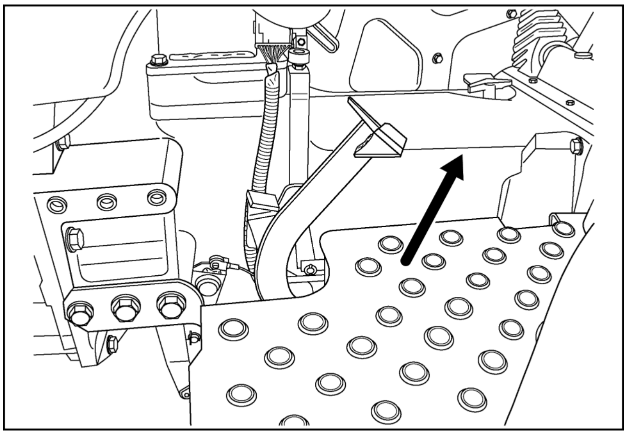
Tractor Identification Location (Stamped)

The tractor serial number, unit code, and engine number are stamped on the top of the clutch housing. these numbers are also repeated on the vehicle identification decal reproduced above.



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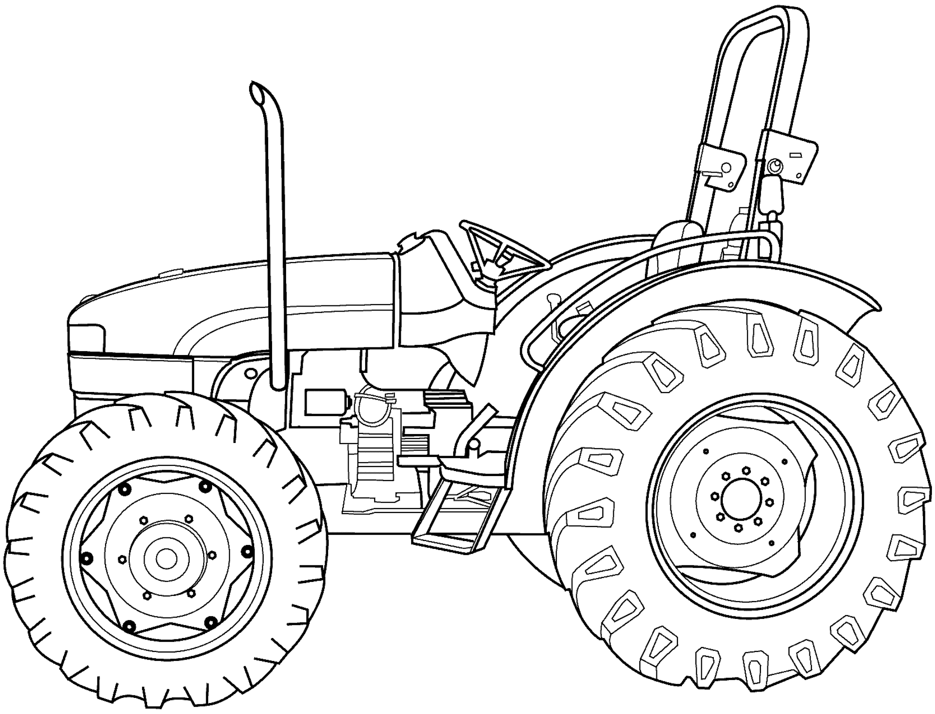
SERVICE MANUAL

HYDRAULIC - PNEUMATIC - ELECTRICAL - ELECTRONIC SYSTEMS



Workmaster 45
Workmaster 55

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Workmaster 45
Workmaster 55

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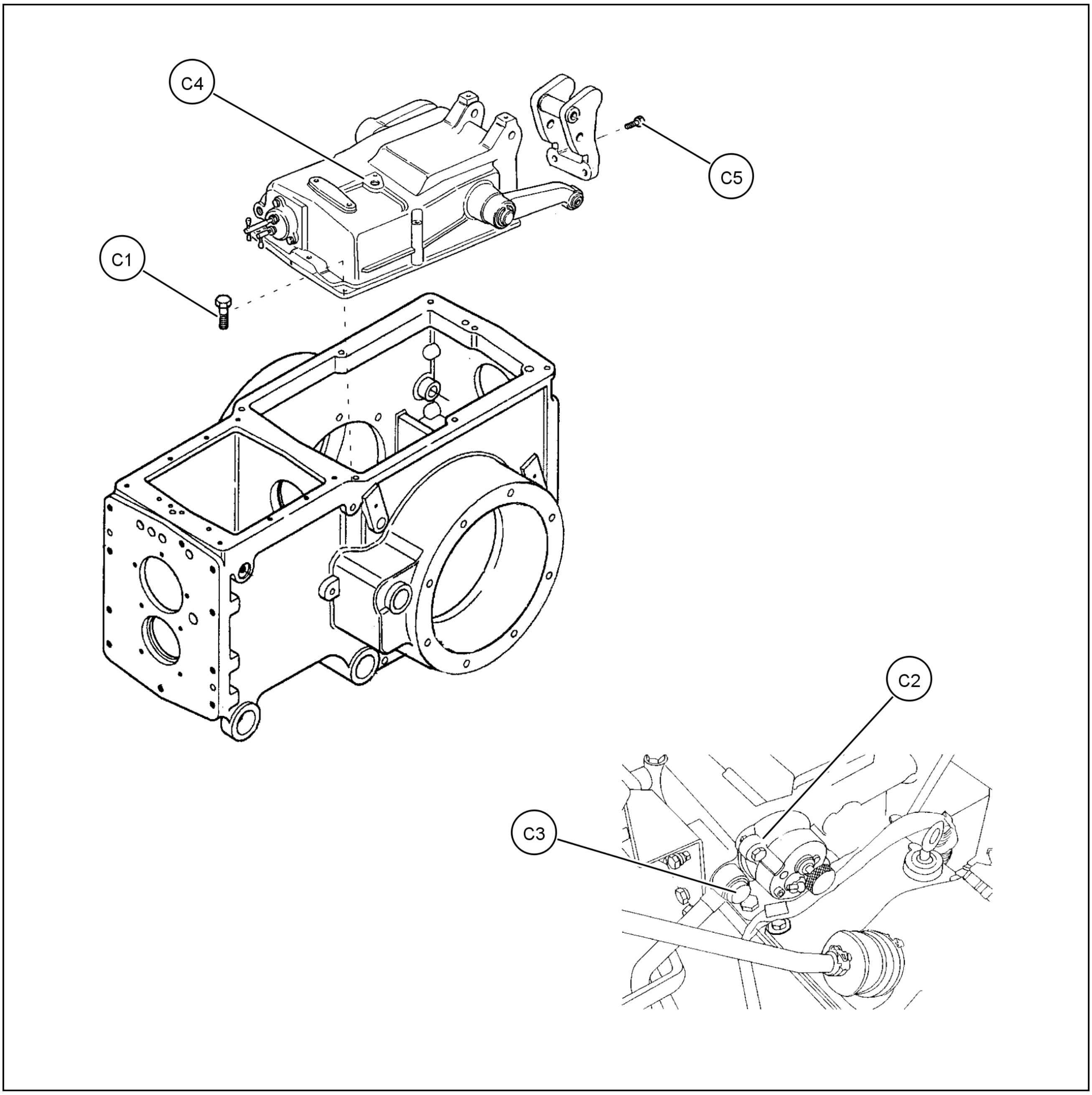
PRIMARY HYDRAULIC POWER SYSTEM - General specification

Type	With separate position control plus float control
Control	Through one independent lever External knob on control valve
Response/drop rate adjustment	Through external knob on control valve
Single-acting cylinder	
Bore and stroke	**85x87.5 mm**
Displacement	**496 cm³**
Pressure regulating valve setting	**17499 - 18002 kPa** (**2538 - 2611 psi**)
Cylinder safety valve setting	**20498 - 21001 kPa** (**2973 - 3046 psi**)
Piston diameter	**84.03 - 84.06 mm** (**3.3083 - 3.3094 in**)
Cylinder bore diameter	**85 - 85.054 mm** (**3.346 - 3.349 in**)
Intervention of automatic hydraulic limit stop	**73 - 74 °**
Internal mechanical limit stop	**76 - 78 °**
Angular excursion of control position lever	**68 °**
Angular excursion of lifting arms in position control	**70 - 72 °**
Cross shaft diameter at the bushings	
Right-hand side	**49.04 - 49.07 mm** (**1.931 - 1.932 in**)
Left-hand side	**44.075 - 44.00 mm** (**1.735 - 1.732 in**)
Shaft end play (with lift arms installed)	**2 mm** (**0.08 in**)
Type	3 - point hitch
Category	I & II
Maximum lifting capacity	**1332 kg** (**2937 lb**)
Maximum lift capacity at standard frame	**925 kg** (**2039 lb**)

PRIMARY HYDRAULIC POWER SYSTEM - Torque

Description	Thread size	Torque
Bolts, lift to housing **(C1)**	M10 x 1.5	**50 N·m** (**37 lb ft**)
Bolts, Distributor to lift housing **(C2)**	M8 x 1.25	**30 N·m** (**22 lb ft**)
Banjo Bolt, Delivery pipe to Distributor **(C3)**	M18 x 1.5	**10 N·m** (**89 lb in**)
Allen screw, Hydraulic cylinder to lift housing **(C4)**	M12 and M14 x 1.25	**75 N·m** (**55 lb ft**)
Bolts, top link support **(C5)**	M8 x 1.25	**50 N·m** (**37 lb ft**)



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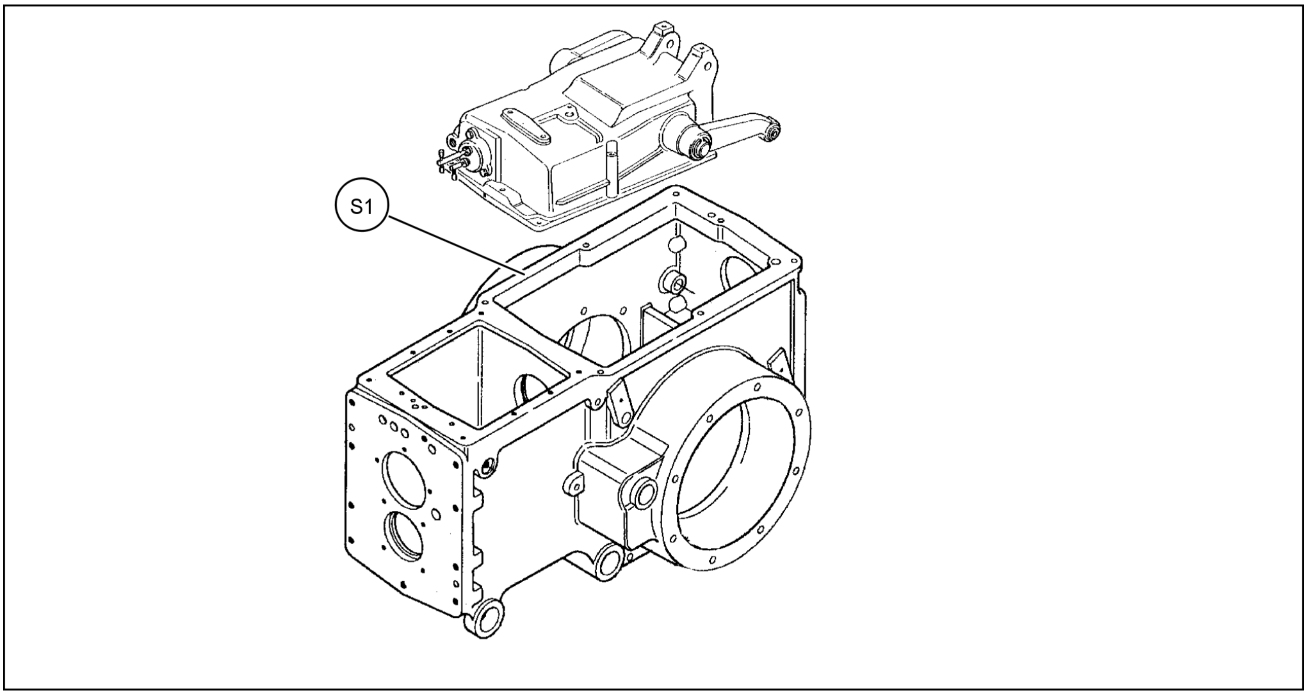
PRIMARY HYDRAULIC POWER SYSTEM - Sealing

Operation Description	Sealant Specification
Lift housing to transmission housing (S1)	**LOCTITE® 518**



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PRIMARY HYDRAULIC POWER SYSTEM - Special tools

Tool Description	Tool No.
Socket for spool height adjustment	380002811

Hydraulic pump - General specification

FILTER	
Type	Full-flow spin on type
Location	On suction pipe before pump intake, on the right-hand side of the engine
PUMP	
Type	Gear type, drawing oil from transmission housing
Location	On the right-hand side of the engine
Mounting	Fitted on engine timing case and driven by timing gears
Make	Dowty
Drive	Engine timing gears
Rotation (from drive end)	Clockwise
Max. speed (with engine running at max. power rated speed)	**2600 - 2800 RPM**
Corresponding normal flow rate	**37 l/min** (**9.8 US gpm**) - WORKMASTER 45 **39.8 l/min** (**10.5 US gpm**) - WORKMASTER 55
Max Pressure	**17499 kPa** (**2538 psi**)

PRIMARY HYDRAULIC POWER SYSTEM - Component identification - Introduction and circuit identification

The hydraulic system on WORKMASTER 45 and WORKMASTER 55 model tractors is used to raise and lower the lift arms of the mechanical lift assembly and to provide hydraulic flow to the remote control valves.

The high pressure hydraulic circuit is a open center type.

In this system hydraulic lift is connected to the hydraulic pump and pump flow is continuously circulating through the hydraulic system even when the circuit are not being operated.

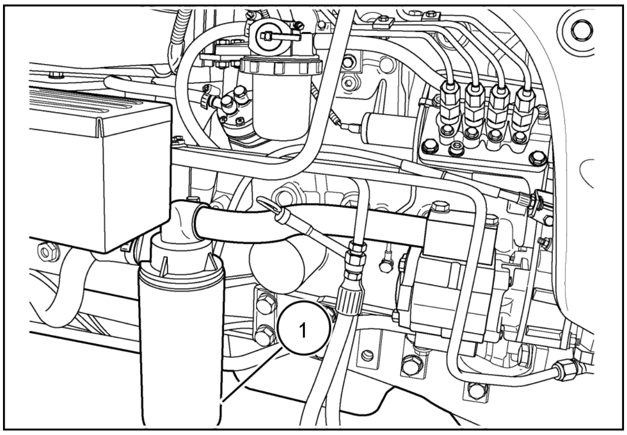
The open center high pressure hydraulic circuit with mechanical lift is shown.

Pump

The open center hydraulic pump assembly is a high pressure gear pump

Filter

The full-flow spin on type filter, **(1)**, is mounted on the right-hand side of the engine.



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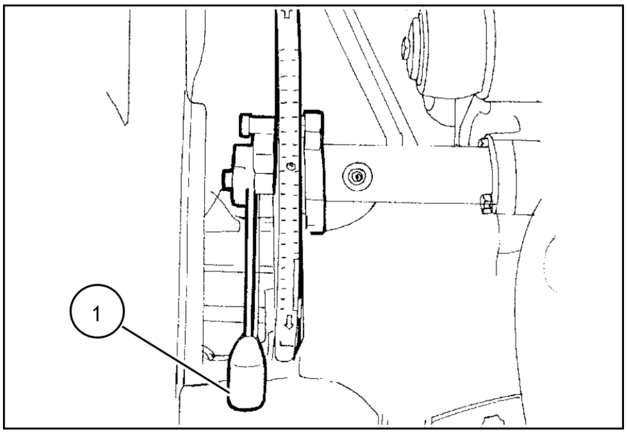
Mechanical Hydraulic Lift Assembly

The following components are located on the lift housing: **POSITION CONTROL LEVER, (1)**.



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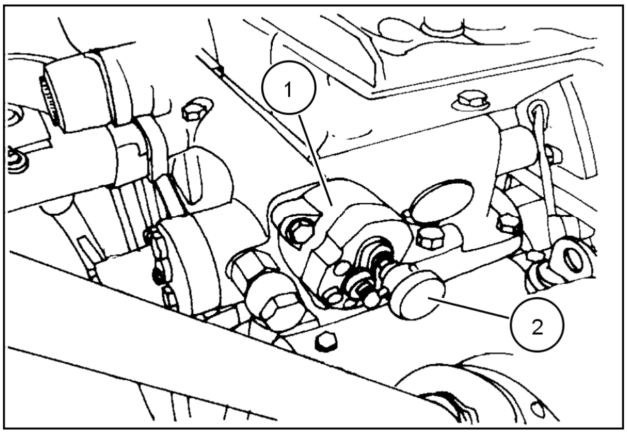
CONTROL VALVE, (1), RESPONSE CONTROL VALVE, (2).



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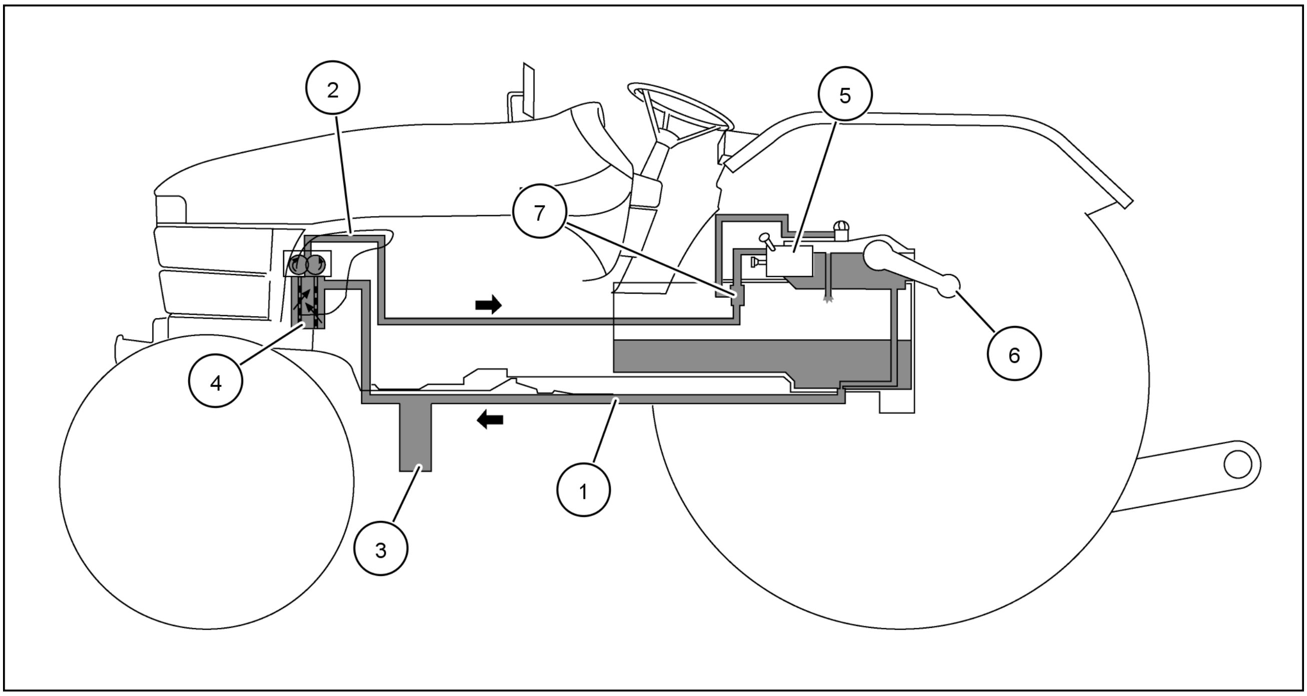
PRIMARY HYDRAULIC POWER SYSTEM - Hydraulic schema Open center hydraulic circuit and mechanical lift

High pressure pump is directly connected on rear side of engine timing gear. Oil is drawn from transmission case through filter. The pump supplies constant oil flow according to engine speed. High pressure oil enters the control valve located at the front of the lift assembly, which controls the raising and lowering of the lift.

All excess oil flow produced by the hydraulic pump is returned direct to the Gear box through the control valve spool located in the control valve.

Also located within the control valve is the lift cylinder safety valve, which protect the lift cylinder and seals from excessive peaks of pressure during operation.

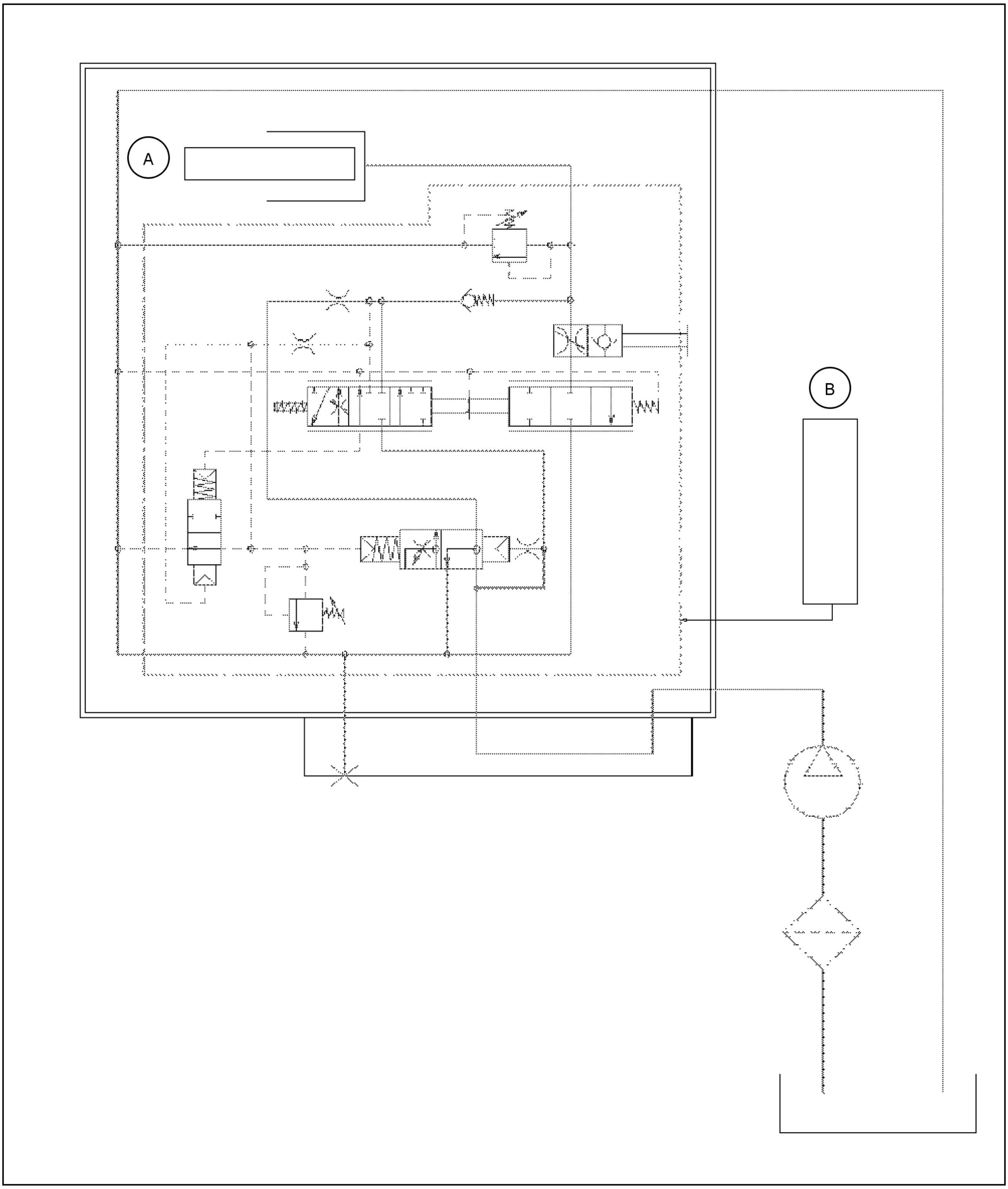
SCHEMATIC VIEW OF HYDRAULIC SYSTEM



56072015 1

1. Suction line drawing from Transmission housing
2. Delivery line to control valve
3. Oil filter
4. Hydraulic pump
5. Relief valve
6. Lift arm
7. Control valve

HYDRAULIC CIRCUIT DIAGRAM



20097463 2

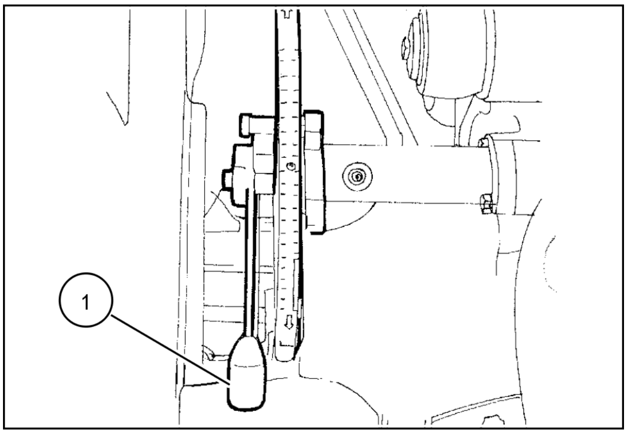
A. Cylinder
B. Control Valve

PRIMARY HYDRAULIC POWER SYSTEM - Static description

HYDRAULIC SYSTEM

This is a live hydraulic system, the gear type hydraulic pump is mounted directly to timing case. The transmission housing serves as a common hydraulic fluid sump. This system described here mechanically operates the three point linkage. The system allows the operator to select Position control and Float control.

NOTICE: *Hydraulic filter is to be changed at regular intervals as recommended. Hydraulic and Transmission parts may get damaged if filter is clogged. Always use Genuine New Holland filters.*



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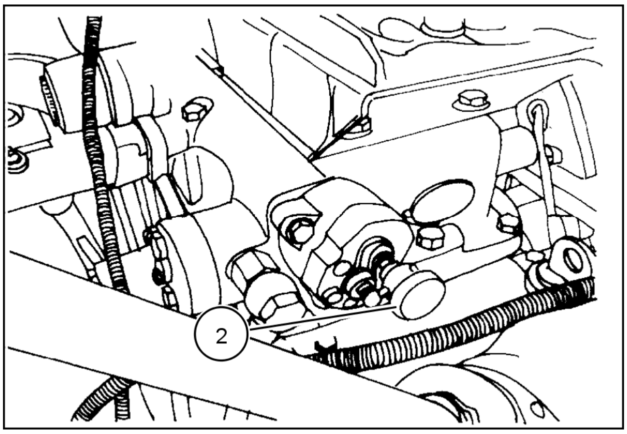
The system is operated by Position control lever, **(1)**, and Response control, **(2)**.

NOTICE: *Some mounted or semi-mounted equipment may interfere with and cause damage to tractor sheet metal. To avoid damage check for clearance between tractor and implements.*



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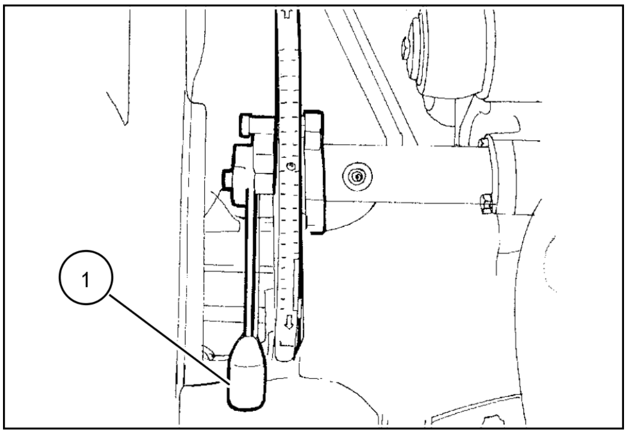
POSITION CONTROL OPERATION

Position control provides accurate control of implements such as sprayers, rakes, rotary tillers etc. that operate above the ground. Once set, Position control will maintain the selected implement height.

Set the required implement height/depth using the Position control lever, **(1)**. Pull the lever back to raise the implement, push forward to lower. Implement height/depth is relative to the position of the lever in quadrant.

An adjustable stop is provided to enable the lever to be returned to the required working position.



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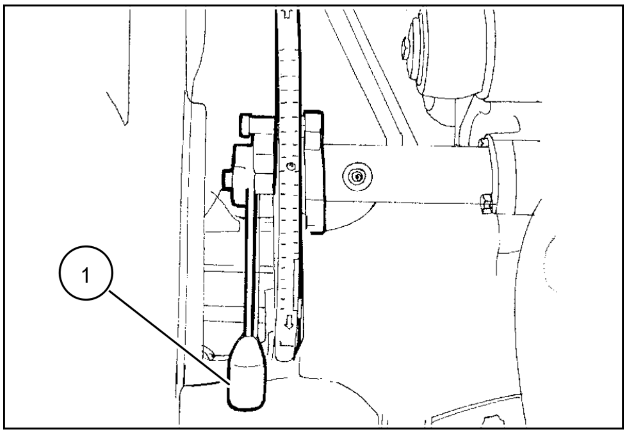
FLOAT OPERATION

Move the Position control lever, **(1)**, fully forward. The 3-point linkage will now be free to float or follow the ground contour, a feature useful for scraper blades etc.



20097494 4

⚠ CAUTION ⚠

When transporting equipment on the 3-point linkage, raise the implement using the Position Control lever. The hydraulic system will maintain the equipment at the height set by the Position Control lever and prevent the equipment lowering and becoming damaged, damaging the road surface or causing personal injury. Failure to comply could result in death or serious injury.

B009

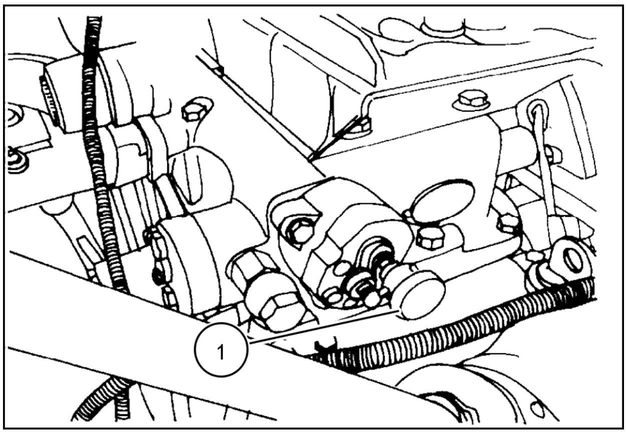
Response Control

The response control knob, **(1)**, varies the speed of drop of the lower links.

CLOCKWISE rotation - Decreases speed of drop.

COUNTERCLOCKWISE rotation - Increases speed of drop.

NOTE: *To lock implements in transport position when driving on road, fully raise Position control lever, **(1)**, Figure **4** and screw in (rotate clockwise) knob, **(1)***



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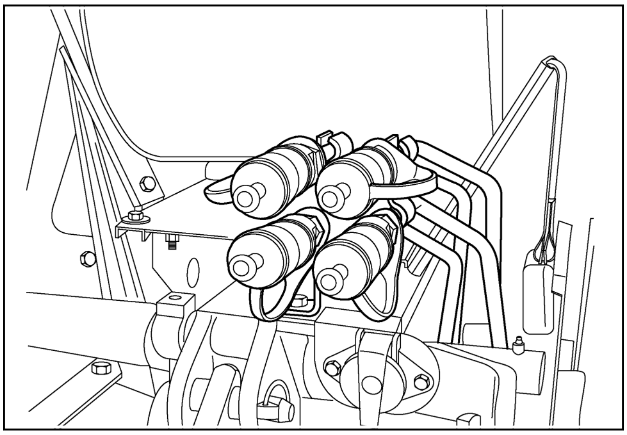
Remote valve - Dynamic description Rear remote valves - Optional

The tractor can be equipped with one or two rear remote hydraulic valves.



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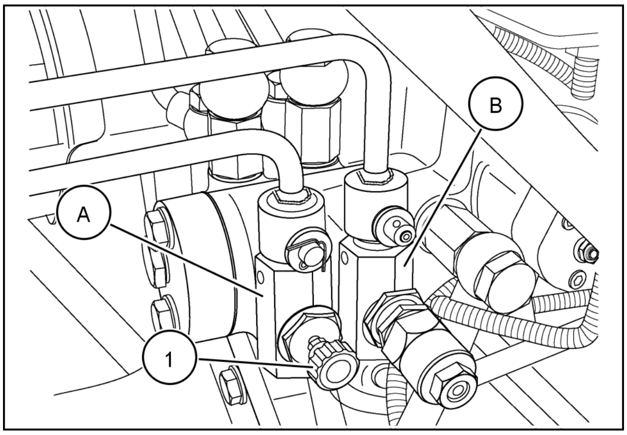
Valves functions can be:

- **(A)** Self centering (with single or double acting cylinder adjustment)
- **(B)** Self centering (with detented float position)

To convert **(A)** style valve to:

- Single acting cylinder turn knob, **(1)**, clockwise.
- Double acting cylinder turn knob, **(1)**, counterclockwise

  NOTE: *Style* ***(B)*** *valve, float detent is non adjustable and does not have a kick out pressure feature.*



86071887 2

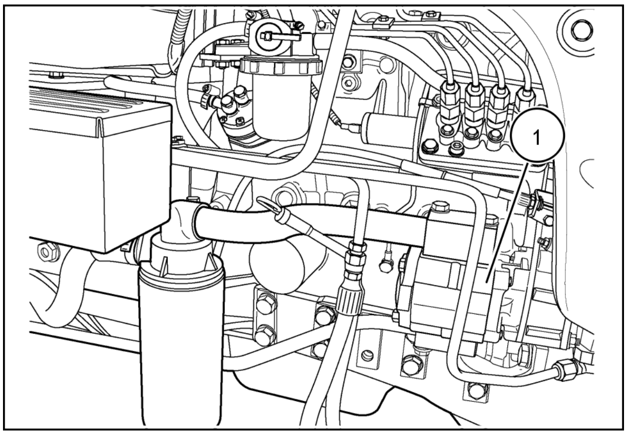
Rear remote valves pressure is, **17499 kPa** (**2538 psi**) which is controlled by the tractor main hydraulic relief valve.

Hydraulic pump - Static description with filter

HYDRAULIC PUMP AND FILTER

The hydraulic pump, **(1)**, is mounted on the right side of the engine and is driven by the engine oil pump gear mounted on the front of the engine block.

The hydraulic pump is a gear type pump and, with exception of replacing the seals, is not user serviceable.



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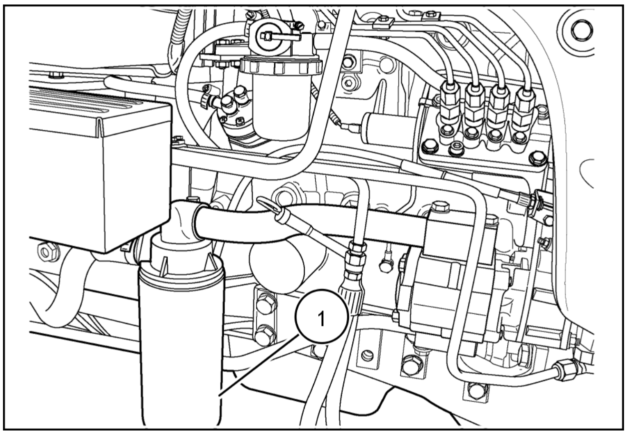
A suction type filter, **(1)**, is located in the inlet line on the right side of the tractor. The filter is serviced by replacing the complete canister assembly. The filter should be replaced after the first 50 hours of use and every 300 hours of use thereafter.



86065627 2

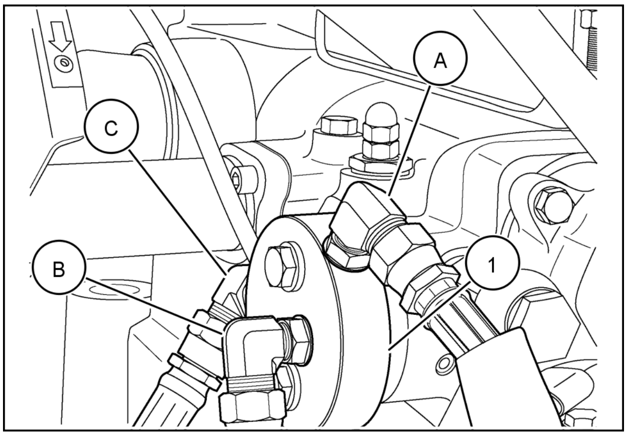
Hydraulic line - Static description Auxiliary hydraulic ports

To obtain auxiliary hydraulic ports for optional hydraulic equipment, an optional hydraulic adapter end cap, **(1)**, has to be installed on the tractor.

End Cap Part # SML53849

This end cap provides the following ports:

- **(A)** Pressure out
- **(B)** Power Beyond
- **(C)** Tank



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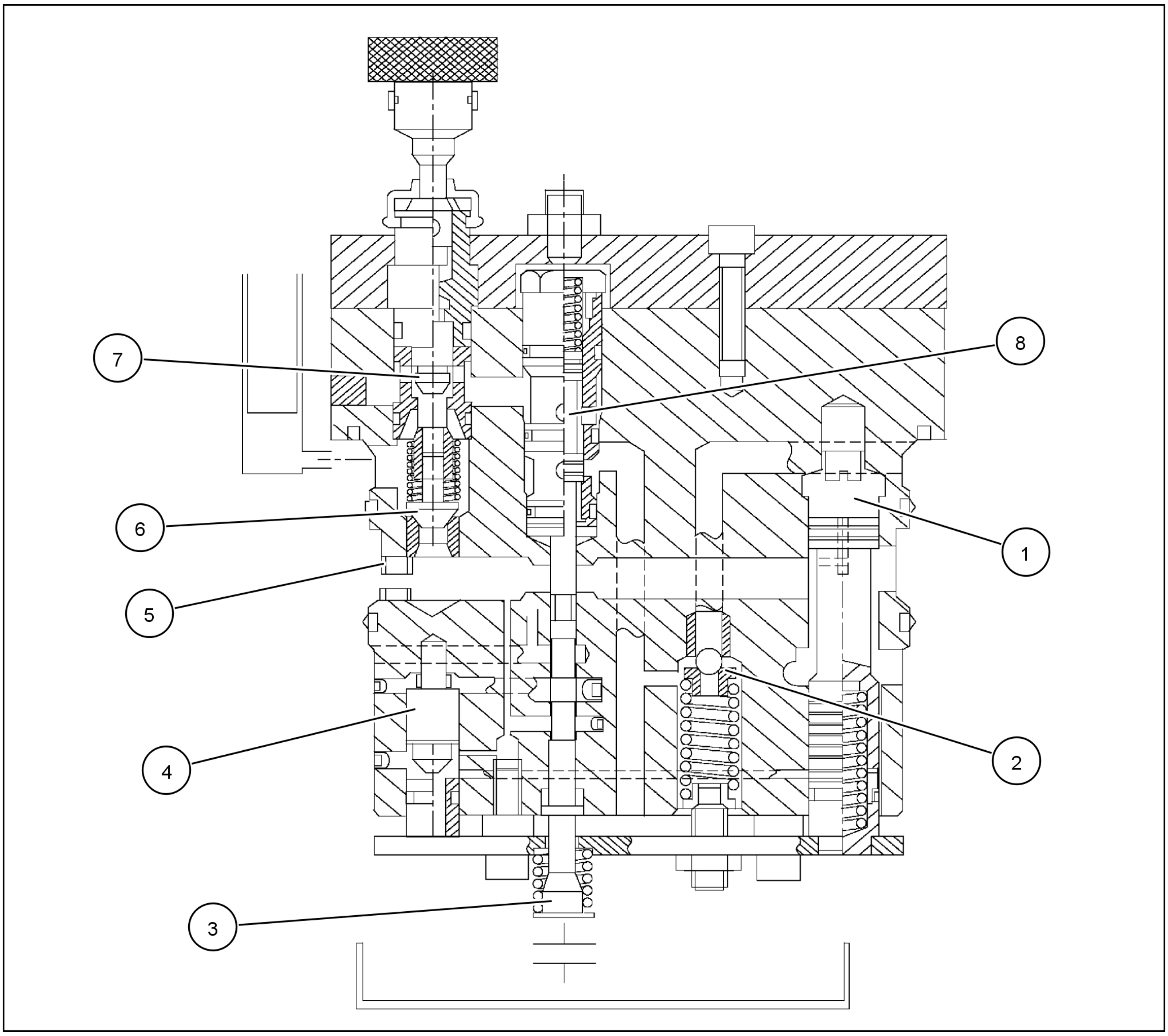
Control valve - Dynamic description

The hydraulic control valve is located in the front portion of the hydraulic lift housing, underneath the tractor seat. The control valve functions are controlled by the position handle and internal linkage contained in the lift housing.

The valve functions are:

- Lift
- Lower
- Neutralize
- Float



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1. Regulator valve assembly
2. Safety valve assembly
3. Control valve spool
4. Pilot valve
5. Orifice
6. Lift check valve
7. Lowering response valve assembly
8. Discharge valve spool

CONTROL VALVE OPERATION

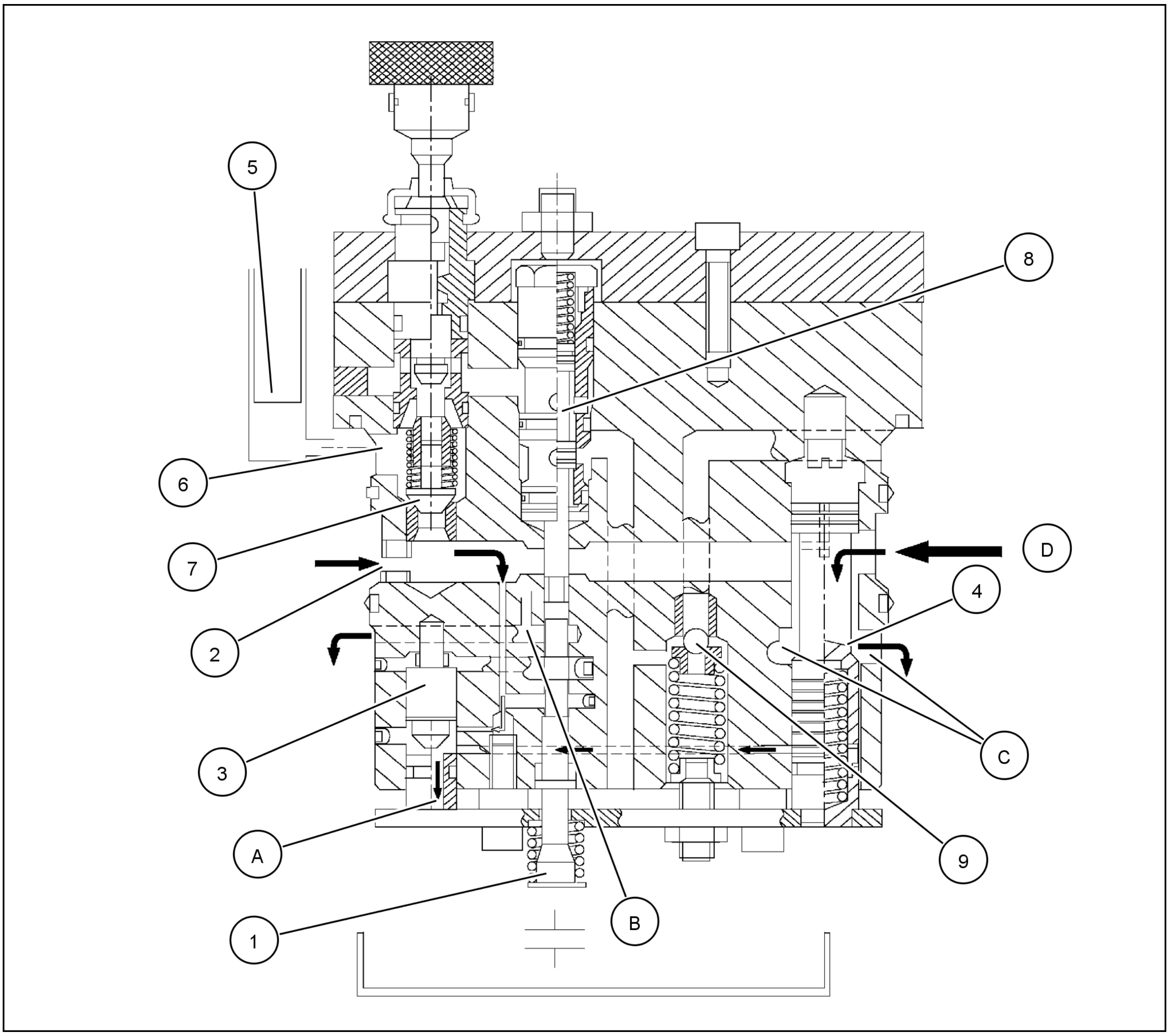
Neutral Position

In the neutral valve position, oil in the lift cylinder is contained under pressure while oil from the hydraulic pump can return freely to sump.

When the control valve spool, **(1)**, in the neutral position, oil flow from the pump is blocked by the valve spool. Oil flow is routed by the annular groove on the outside of the valve body and through orifice, **(2)**, to the pilot valve, **(3)**. The oil flow allows the pilot valve, to unseat which allows oil to discharge from ports **(A)** and **(B)**. Oil on the back side of the regulator valve, **(4)**, escapes through port **(A)**. The regulator valve is allowed to shift and opens port **(C)**. Port **(C)** allows the pump oil flow to return to sump.

The oil contained in the lift cylinder, **(5)**, is connected to the valve by annular groove, **(6)**, on the outside of the valve body. Oil in the cylinder remains under pressure because the check valve, **(7)**, discharge valve, **(8)**, and safety valve, **(9)**, are closed.

The safety valve protects the lift cylinder from excessive pressure exerted by the load on the lift arms during transport.



20097898 2

Neutral Position

D Pump flow

-

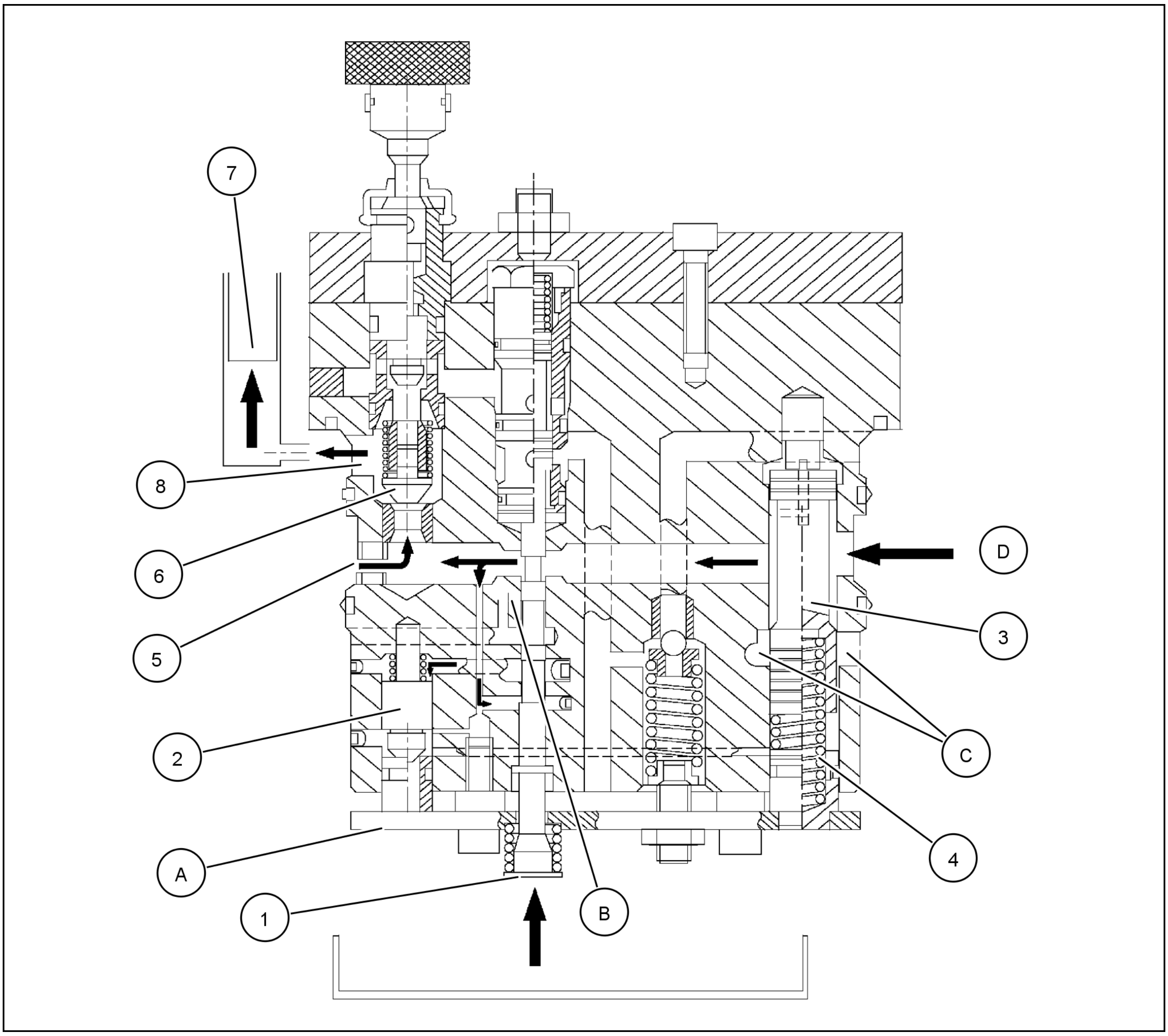
Lifting Position

In the lifting position, oil under pressure from the hydraulic pump is supplied to the lift cylinder, which allows the lift arms to raise.

The control valve spool, **(1)**, is shifted inward, allowing the oil from the hydraulic pump to flow past the valve spool. The control valve spool, closes the port **(B)**, when port **(B)** is closed, pressure oil is supplied to the top of the pilot valve, **(2)**. This pressurized oil seats the pilot valve, which closes port **(A)**. When port **(A)** is closed, oil on the back side of the regulator valve, **(3)**, is trapped and with the aid of the regulator valve spring, 4, the regulator valve shifts upward and closes port **(C)**.

The pressurized oil from the hydraulic pump flow past the control valve spool and also into the annular groove on the outside of the valve body and through orifice, **(5)**. When the pump supplied oil pressure overcomes the pressure exerted by the load on the lift arms, the check valve, **(6)**, opens and supplies oil to the lift cylinder, **(7)**, through annular outside groove, **(8)**.

Maximum hydraulic pressure is regulated by the hydraulic relief valve that is mounted externally to the hydraulic lift cover. Max pressure is set to **17499 kPa** (**2538 psi**).



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Lifting Position

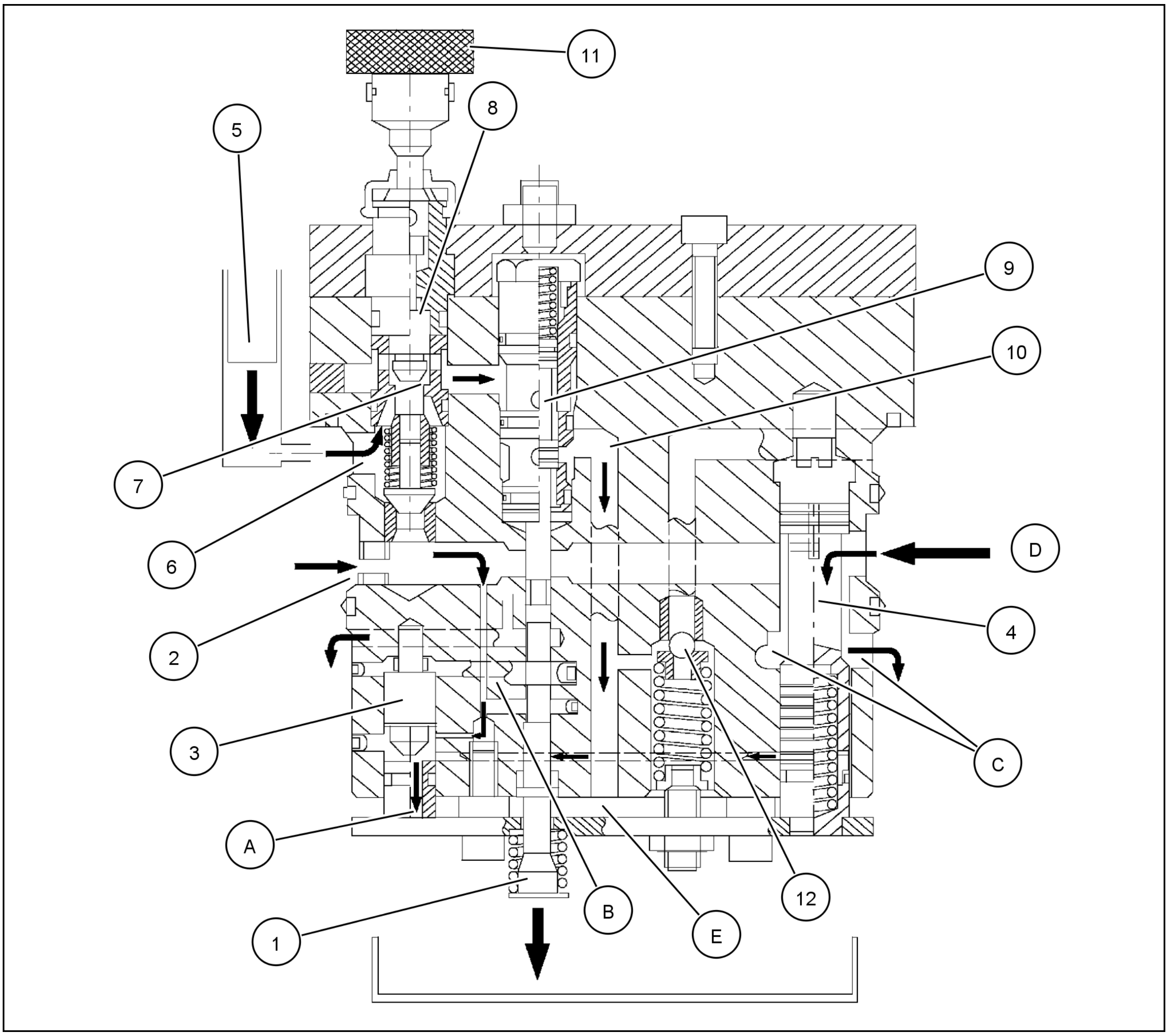
D Pump flow
-

Lowering Position

The control valve spool, **(1)**, shifts outward and oil flow from the pump is blocked by the valve spool. Oil flow is routed by the annular groove on the outside of the valve body and through orifice, **(2)**, to the pilot valve, **(3)**. The oil flow allow the pilot valve, to unseat which allows oil to discharge from ports **(A)** and **(B)**. Oil on the back side of the regulator valve, **(4)**, escapes through port **(A)**. The regulator valve is allowed to shift and opens port **(C)**. Port **(C)** allows the pump oil flow to return to sump

Oil discharged from the lift cylinder, **(5)**, flows through the annular groove, **(6)**, located on the outside of the valve body. Oil is routed through discharge port, **(7)**, and past the lowering response valve, **(8)**. Spring pressure on the discharge valve spool, **(9)**, aligns the spool with oil galley, **(10)**, and allows the discharge oil from the lift cylinder to flow to sump through port **(E)** and allows the lift arms to lower.

During the lowering mode, the lowering speed can be regulated by the lowering response valve, **(8)**. Rotate knob, **(11)**, clockwise to decrease lowering speed or counterclockwise to increase lowering speed. If the lowering response speed valve is totally closed and the tractor is transporting a load, any pressure exerted by the load on the lift arms that exceed the safety valve, **(12)**, pressure setting, will open the safety valve and allow the oil from the lift cylinder to flow to sump.



20097900 4

Lowering Position

D Pump flow
-

CONTROL VALVE INTERNAL LINKAGE

Position Control - Raise Mode viewed from left side of tractor

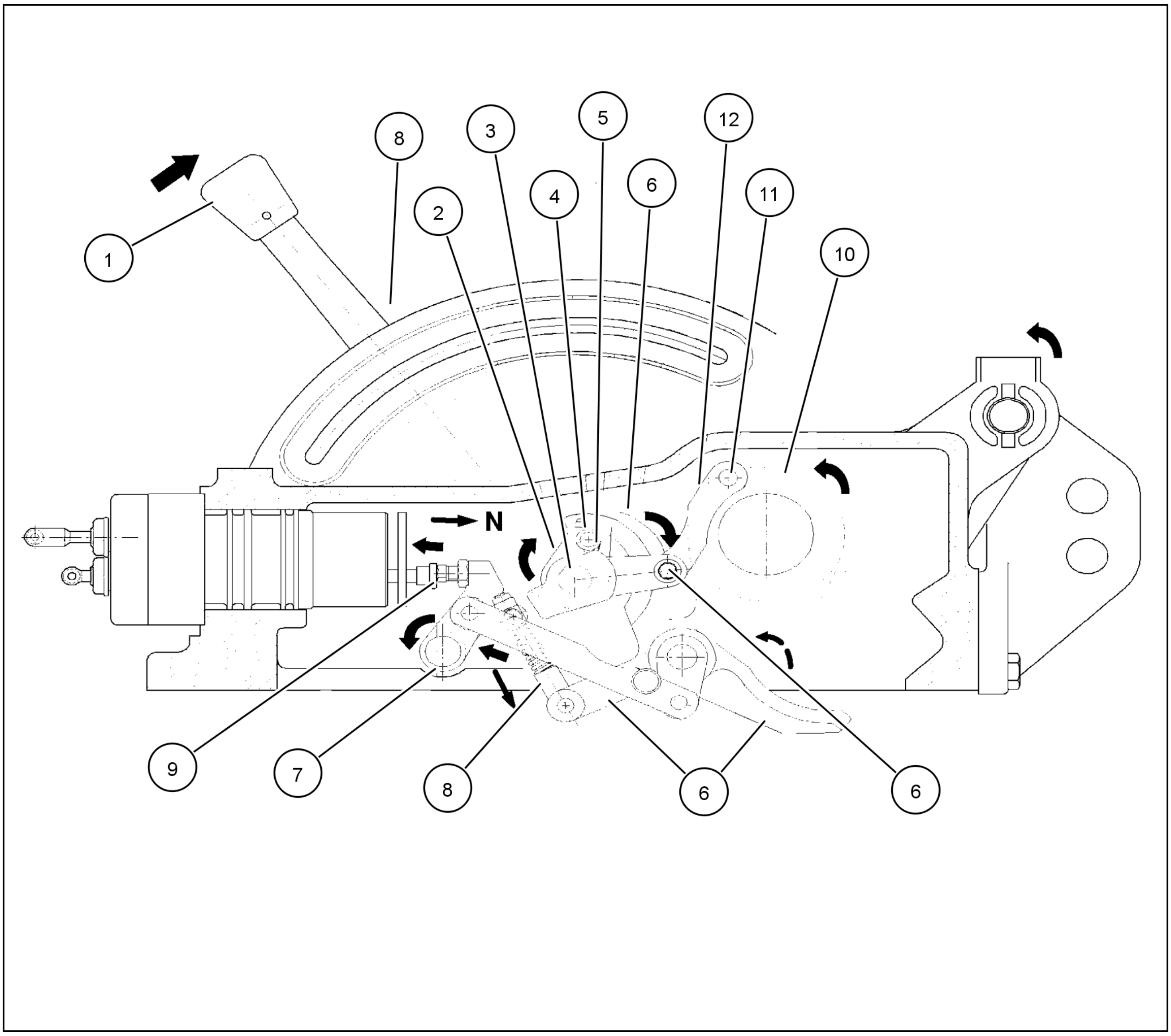
When the position control lever, **(1)**, is moved rearward, the lift arms will raise an amount accordingly to lever position.

When moving the position control lever, **(1)**, rearward, the bell crank, **(2)**, which is locked to shaft, **(3)**, rotates in a clockwise rotation and causes roller, **(4)**, to slide on the position cam, **(5)**, in turn causing the cam lever assembly, **(6)**, to rotate clockwise.

When the cam lever assembly rotates clockwise, it pushes the valve actuation lever, **(7)**, in a counterclockwise rotation, by means of the spring loaded shock absorber, **(8)**, this counterclockwise rotation of the valve actuation lever, **(7)**, pushes in on the control valve, **(9)**, spool and the rear lift arms raise.

During the lifting movement of the lift arms, the cross shaft crank, **(10)** with pin, **(11)**, will rotate in a counterclockwise rotation and by the means of the connector link, **(12)**, the link will cause the position cam, **(5)**, to rotate clockwise.

When roller, **(4)**, contacts the peak spot on position cam, **(5)**, the linkage trips, allowing cam lever assembly, **(6)**, to rotate counterclockwise, which pulls on the spring loaded shock absorber, **(8)**. This pulling of the shock absorber, causes the valve actuation lever, **(7)**, to release the pressure on the control valve spool, **(9)**, and allow the valve to return to the neutral position. When the valve is returned to the neutral position, the lifting movement of the arms will stop.



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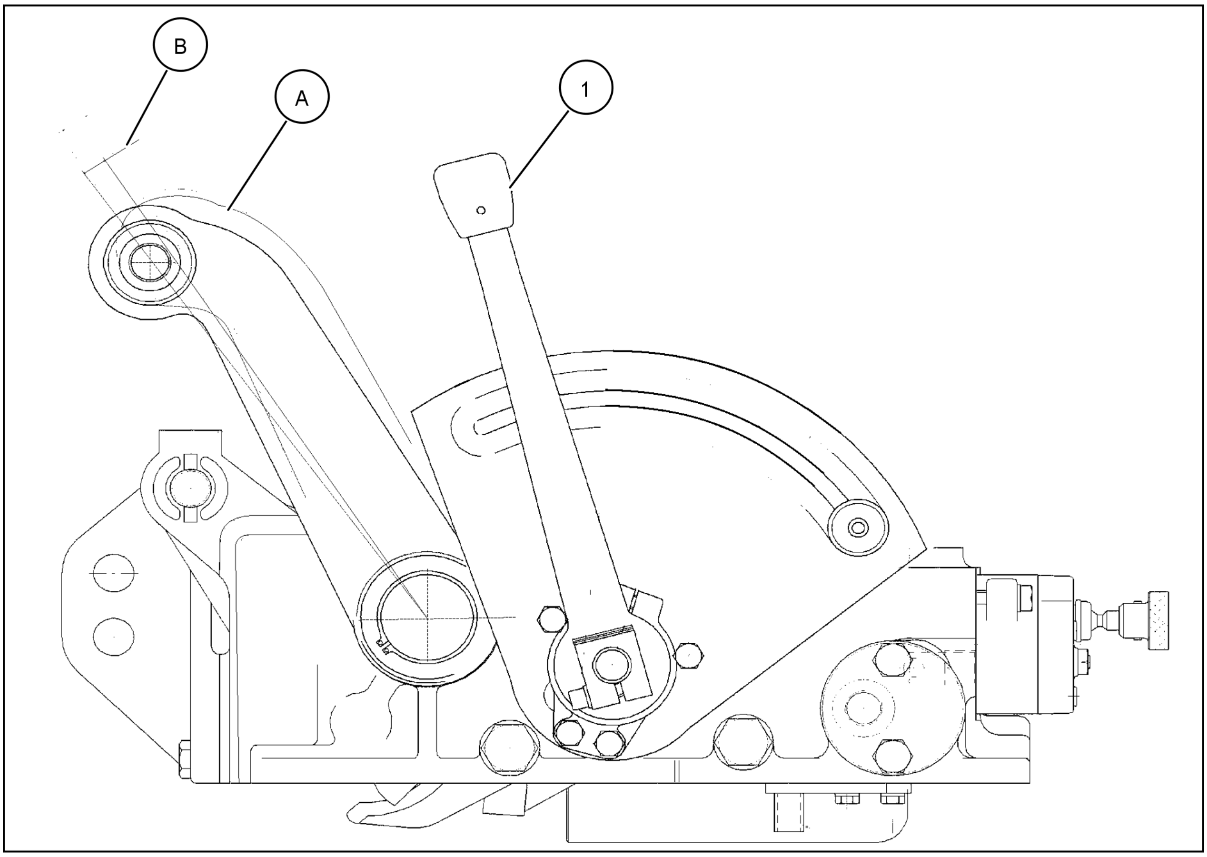


20097478 6

A - Hydraulic lifting arm at the end of stroke
B - **10 - 15 mm** (**0.4 - 0.6 in**)

USE OF POSITION CONTROL LEVER

The movement of the arms is proportional to the movement of lever, **(1)**.

Fix the implement position, inside or outside the soil, by the moving lever, **(1)**, rearward for raising and frontward for lowering.

PRIMARY HYDRAULIC POWER SYSTEM - Remove Mechanical lift assembly

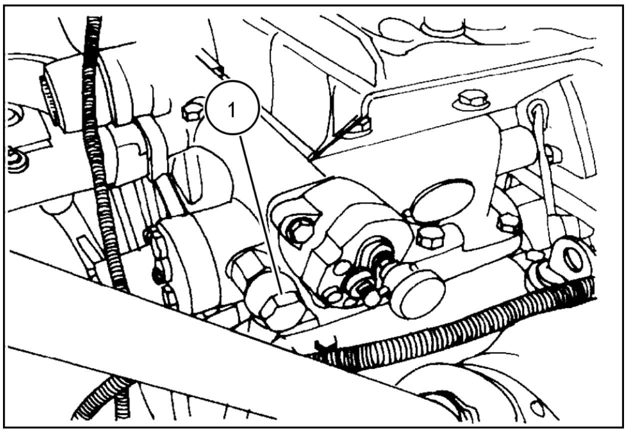
⚠ **WARNING** ⚠

Handle all parts carefully. Do not put your hands or fingers between parts. Always wear suitable safety items such as fitted clothing, safety goggles, gloves, shoes, etc. Failure to comply could result in death or serious injury.

M954A

Remove the hydraulic lift from the rear axle housing as follows:

1. Disconnect the delivery pipe, **(1)**, from control valve.



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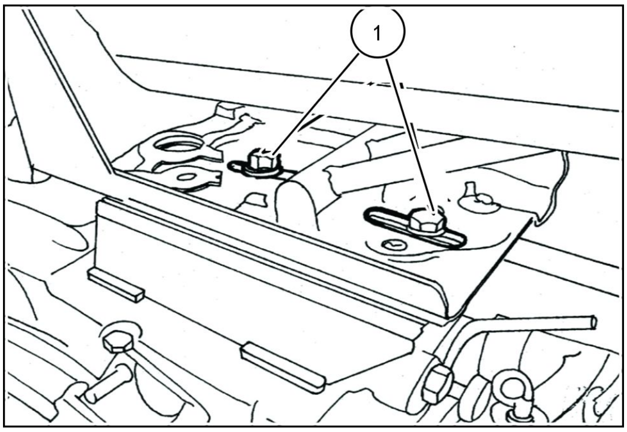
2. Loosen the bolts, **(1)**, and remove the operator’s seat from the hydraulic lift.



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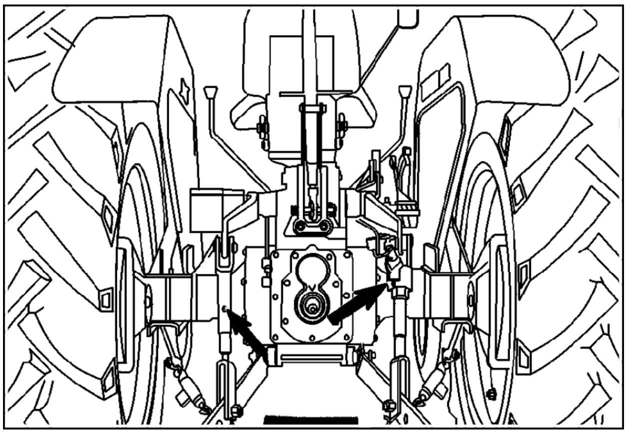
3. Remove the three-point linkages (top link, lower link and lift rod) from the tractor.



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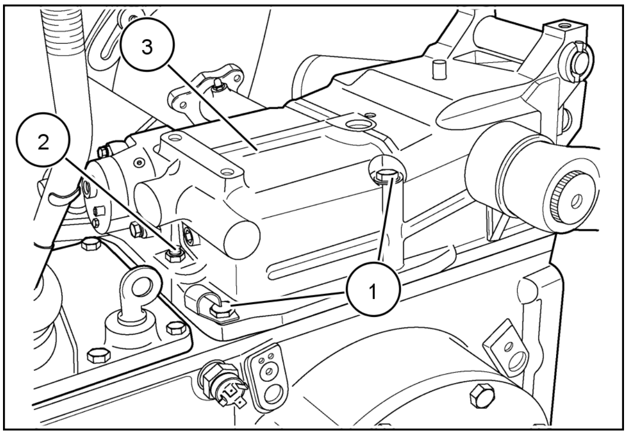
4. Remove the bolts, **(1)**, and nut, **(2)**, securing hydraulic lift housing, **(3)**, to transmission housing.
5. Lift the hydraulic lift assembly using suitable hoist and place it on a flat surfaced table.

NOTICE: *Never lift the housing by holding distributor knobs and delicate parts.*



86065628 4

Next operation:
PRIMARY HYDRAULIC POWER SYSTEM - Disassemble - Rear lift internal controls (A.10.A)

PRIMARY HYDRAULIC POWER SYSTEM - Disassemble - Rear lift internal controls

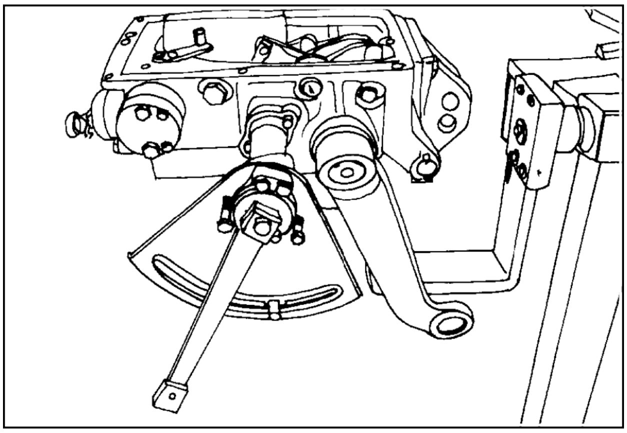
Prior operation:
PRIMARY HYDRAULIC POWER SYSTEM - Remove Mechanical lift assembly (A.10.A)

⚠ **WARNING** ⚠

Handle all parts carefully. Do not put your hands or fingers between parts. Always wear suitable safety items such as fitted clothing, safety goggles, gloves, shoes, etc. Failure to comply could result in death or serious injury.

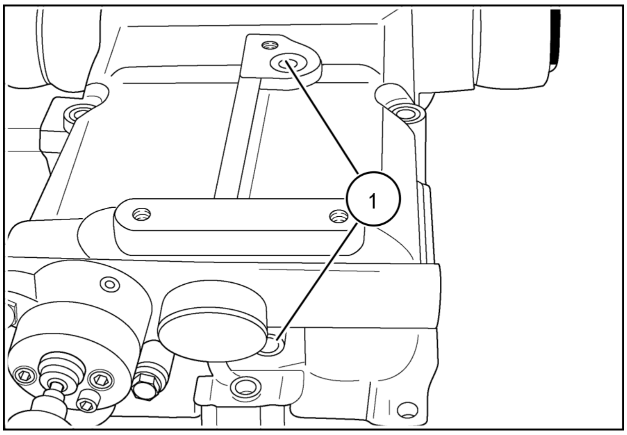
M954A

1. Remove the lift assembly from the transmission housing and install on a rotary stand.



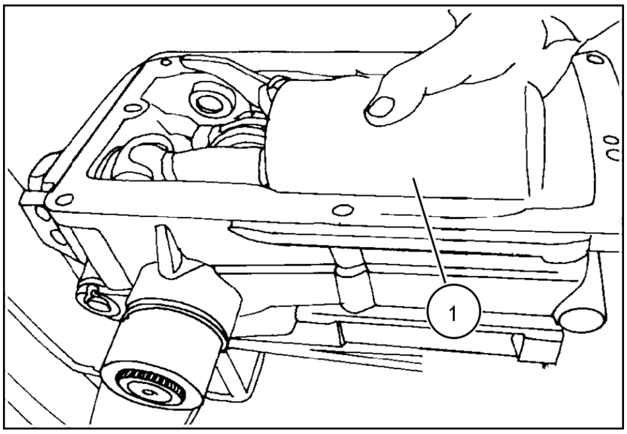
20097475 1

2. Remove the socket head cap screws, **(1)**.



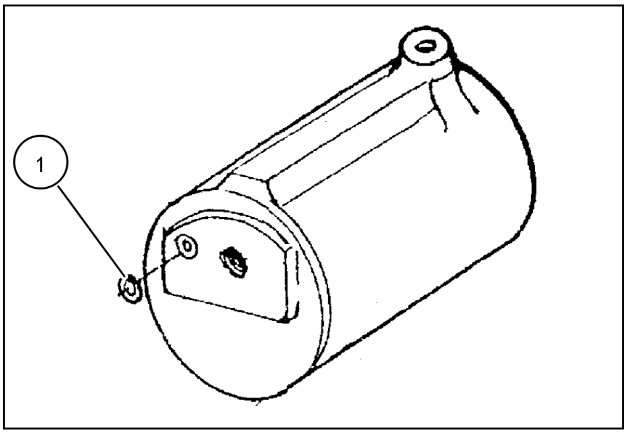
86070603 2

3. Remove the cylinder, **(1)**, from hydraulic lift housing.



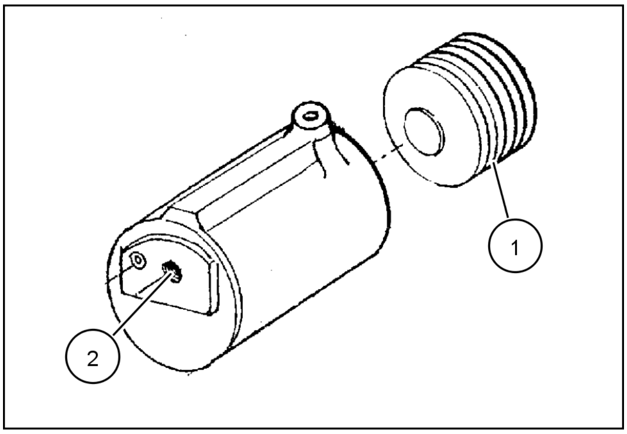
20097474 3

4. Remove the seal, **(1)**, from head of cylinder.



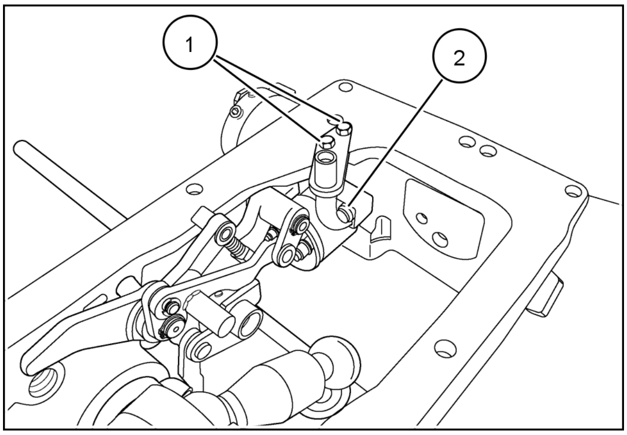
20097473 4

5. Remove the piston, **(1)**, from the cylinder by pushing with a suitable aluminum rod from the front side, through access hole, **(2)**.



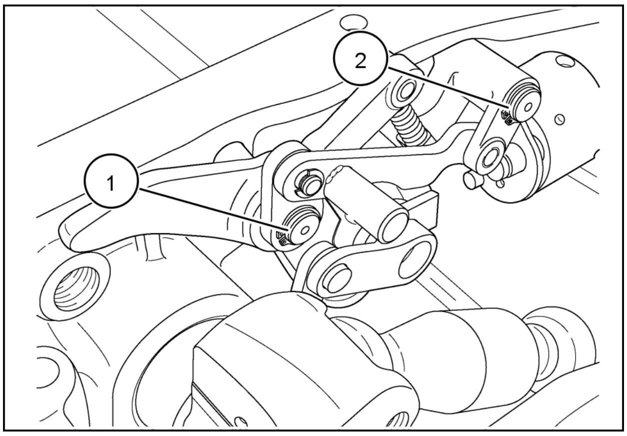
20097472 5

6. Remove the bolts, **(1)**, securing the lubrication pipe, **(2)**.



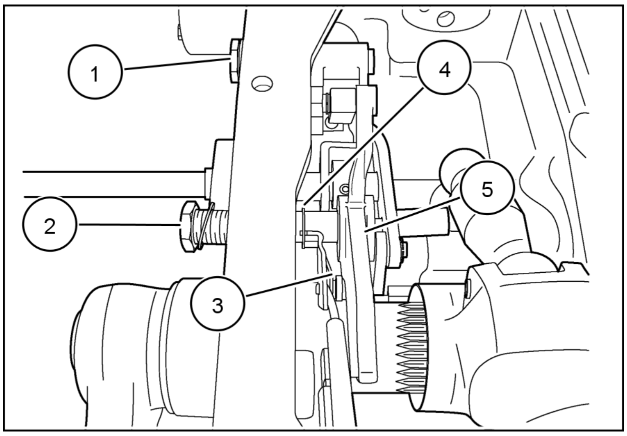
86070604 6

7. Remove the snap ring, **(1)** and **(2)**.



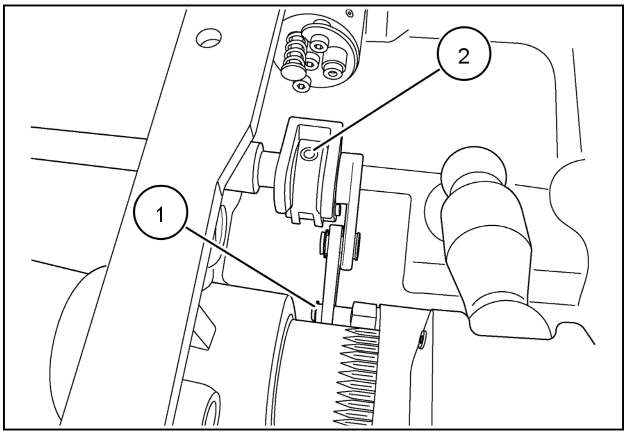
86070605 7

8. Remove the bolt, **(1)**, that secures the front of the linkages.
9. While removing the linkage bolt, **(2)**, use a pair of snap ring pliers, **(3)**, to keep the snap ring, **(4)**, open.
10. Remove the linkage assembly, **(5)**, from the housing.



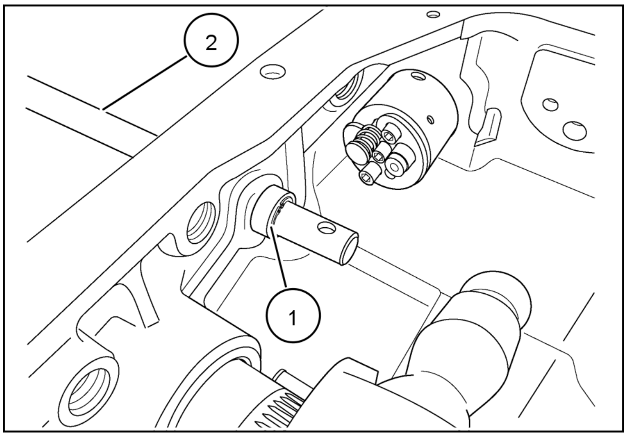
86070606 8

11. Remove the retaining clip, **(1)**.
12. Remove the hex retaining screw, **(2)**.
13. Remove the shaft linkages from the housing.



86070607 9

14. Remove the snap ring, **(1)**, from shaft.
15. Remove the shaft, **(2)**, from the housing.



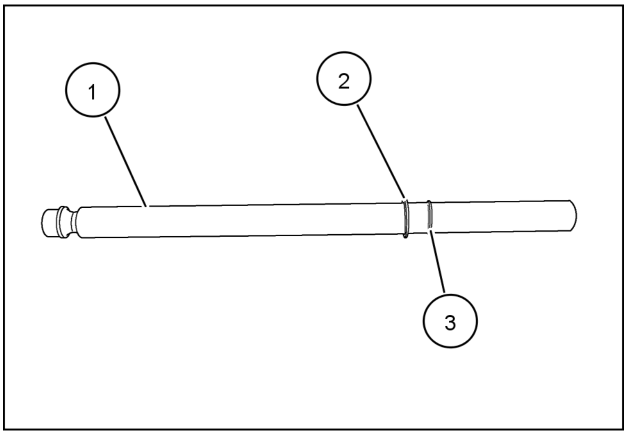
86070610 10

Next operation:
PRIMARY HYDRAULIC POWER SYSTEM - Inspect Rear lift internal controls (A.10.A)

PRIMARY HYDRAULIC POWER SYSTEM - Inspect Rear lift internal controls

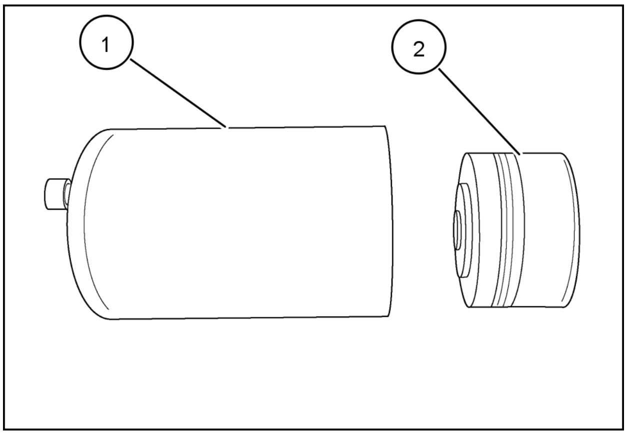
Prior operation:
PRIMARY HYDRAULIC POWER SYSTEM - Disassemble - Rear lift internal controls (A.10.A)

1. Inspect the shaft, **(1)**, and outer snap ring, **(2)**, for wear and replace as needed.
2. Before assembly, replace the shaft O-ring, **(3)**.



86070608 1

3. Inspect the cylinder housing, **(1)**, for excessive wear and replace as needed.
4. Replace the cylinder seal, **(2)**, and the plastic ring under seal, not shown.



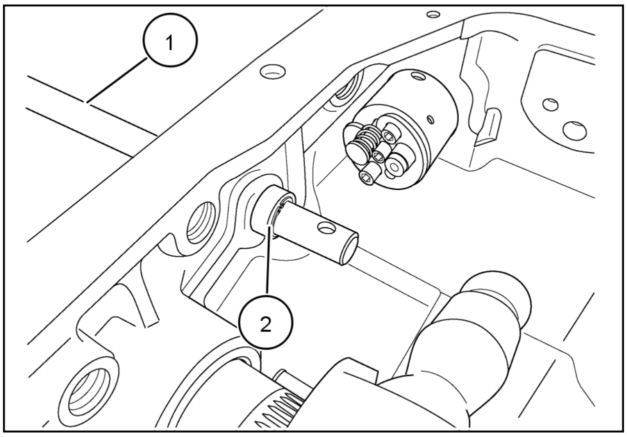
86070609 2

Next operation:
PRIMARY HYDRAULIC POWER SYSTEM - Assemble Rear lift internal controls (A.10.A)

PRIMARY HYDRAULIC POWER SYSTEM - Assemble Rear lift internal controls

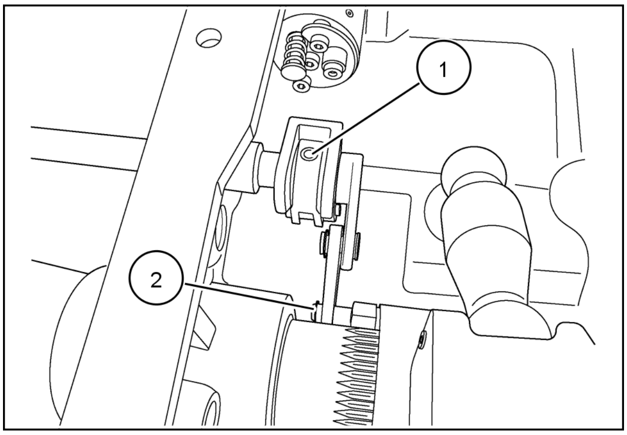
Prior operation:
PRIMARY HYDRAULIC POWER SYSTEM - Inspect Rear lift internal controls (A.10.A)

1. Apply a coat of hydraulic fluid to the O-ring on the shaft and install the shaft, **(1)**, into the housing.
2. Secure the snap ring, **(2)**, on shaft.



86070610 1

3. Install the shaft linkages as shown.
4. Secure the hex retaining screw, **(1)**, into the indentation on the end of the shaft, not shown.
5. Install the retaining clip, **(2)**.

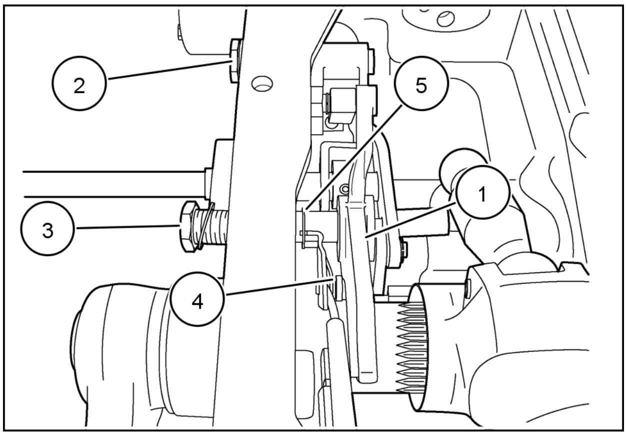


86070607 2

6. Install the linkage assembly, **(1)**, into the housing as shown.

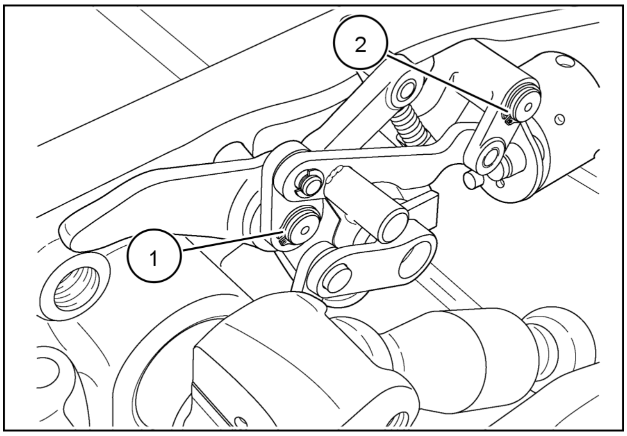
NOTICE: *After installing the linkages, make sure the adjusting nut is in line with the plunger on the HPL valve.*

7. Install the bolt, **(2)**, that secures the front on the linkages.
8. While installing the linkage bolt, **(3)**, use a pair of snap ring pliers, **(4)**, to keep the snap ring, **(5)**, open.
9. After the linkage bolt, **(3)**, is installed, engage the snap ring into the groove on the bolt.



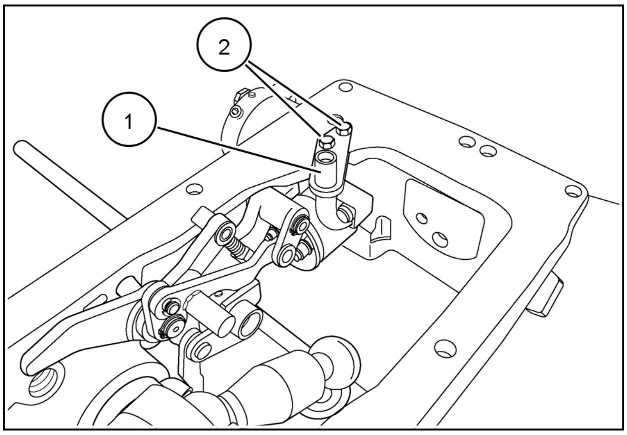
86070606 3

10. Secure the linkage assembly to the bolts with snap ring, **(1)** and **(2)**, from removal.



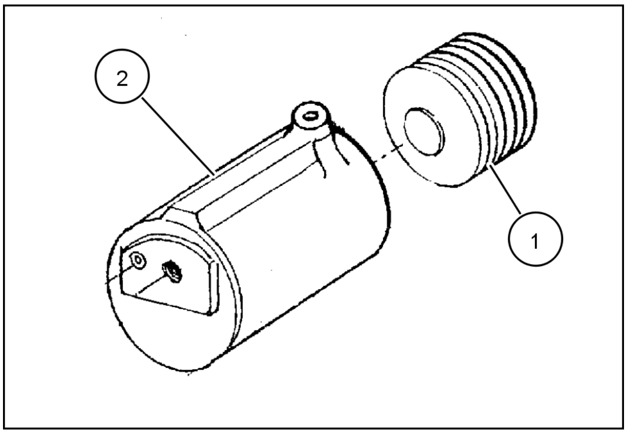
86070605 4

11. Install the lubrication pipe, **(1)**, and secure with bolts, **(2)**.



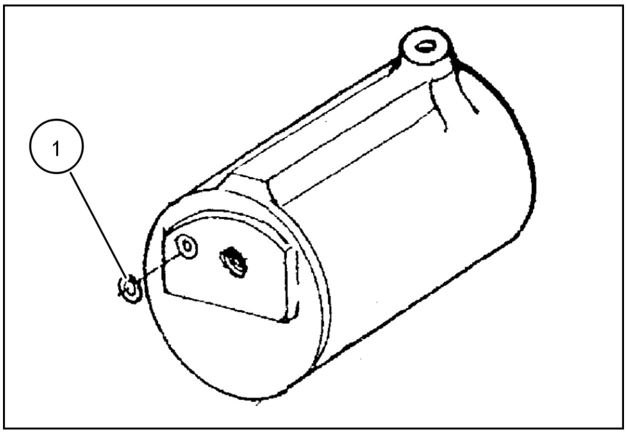
86070604 5

12. Put a light coat of the hydraulic fluid on the seal and install the piston, **(1)**, into the cylinder housing, **(2)**.



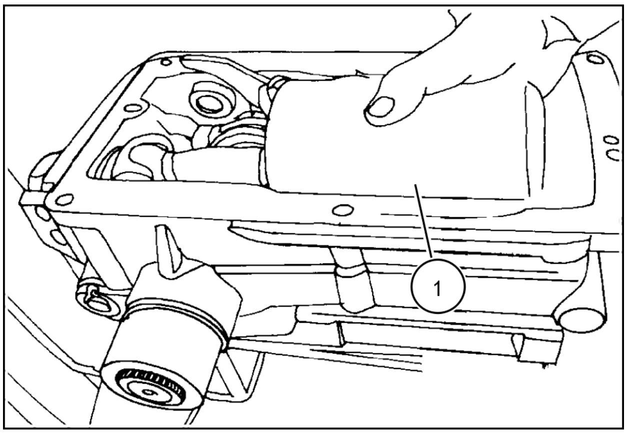
20097472 6

13. Install a new seal, **(1)**, onto the head of the cylinder housing.



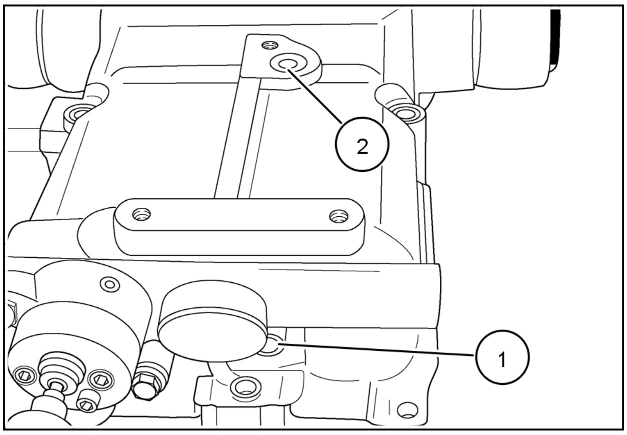
20097473 7

14. Install the cylinder housing, **(1)**, into the hydraulic lift housing.



20097474 8

15. Secure the cylinder with the M12 socket head cap screws, **(1)**. Torque the socket head cap screws to **75 N·m** (**55 lb ft**).



86070603 9

Next operation:
PRIMARY HYDRAULIC POWER SYSTEM - Install Mechanical lift assembly (A.10.A)

PRIMARY HYDRAULIC POWER SYSTEM - Install Mechanical lift assembly

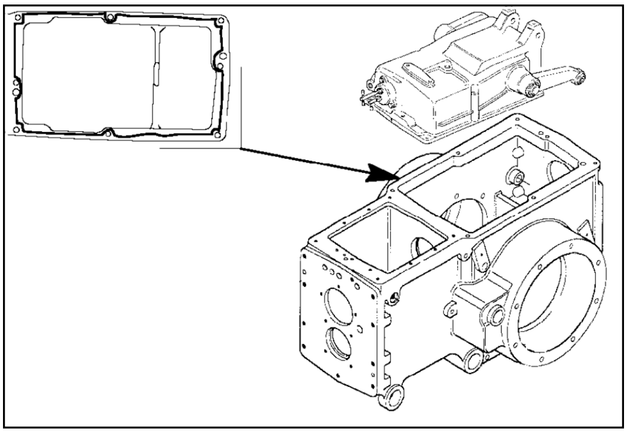
Prior operation:
PRIMARY HYDRAULIC POWER SYSTEM - Assemble Rear lift internal controls (A.10.A)

⚠ WARNING ⚠

Always use suitable tools to align holes. DO NOT USE HAND OR FINGERS. Failure to comply could result in death or serious injury.

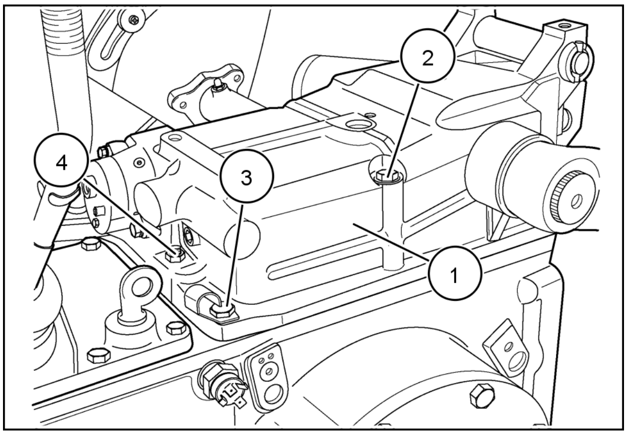
B020A

1. Before installing the hydraulic lift assembly on the transmission housing, thoroughly clean and degrease the mating surfaces and apply a **2 mm** (**0.08 in**) bead of **LOCTITE 518** sealer, as shown.



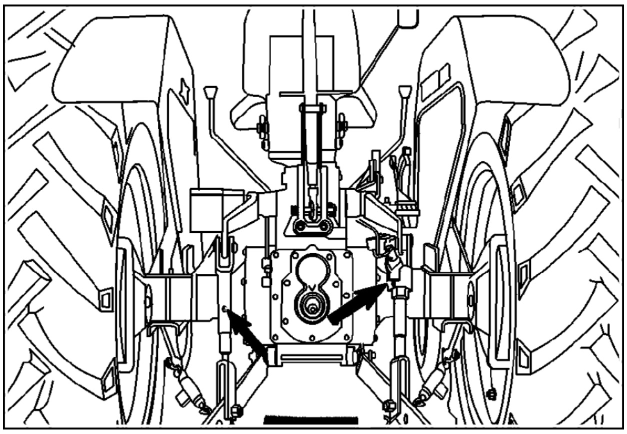
20097476 1

2. Install the hydraulic lift assembly, **(1)**, using a suitable hoist.
3. Secure the lift assembly using the M10 x 110 bolts, **(2)**, M10 x 32 bolts, **(3)**, M10 x 25 bolt (not shown), and M10 nut, **(4)**.
4. Torque all hardware to **50 N·m** (**37 lb ft**)



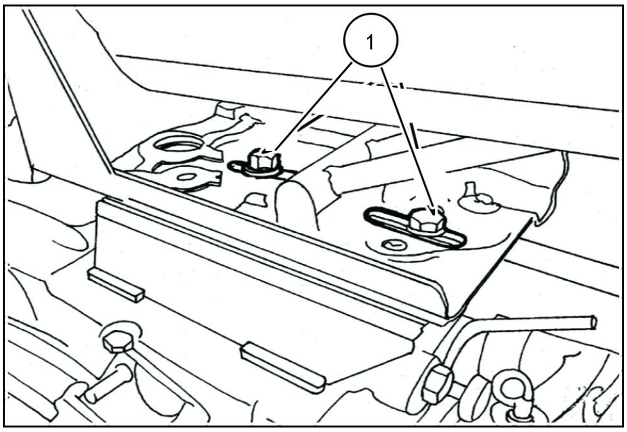
86065628 2

5. Install the three-point linkages (top link, lower link, and lift rod) onto the tractor.



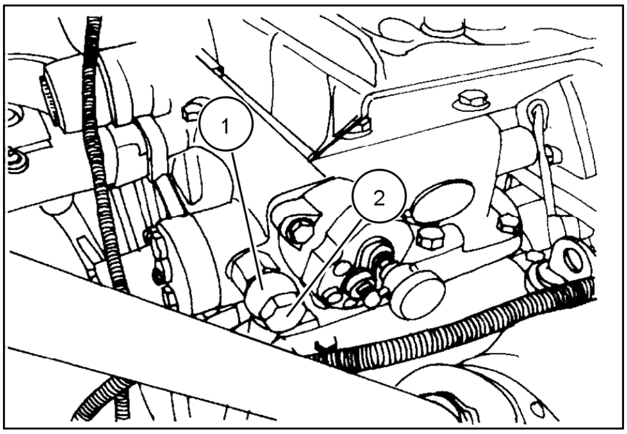
20097477 3

6. Install the operator's seat onto the hydraulic lift housing and secure with bolts, **(1)**, from removal.



20093438 4

7. Attach the delivery pipe, **(1)**, to the distributor.
8. Secure using the M18 banjo bolt, **(2)**.



20097480 5

PRIMARY HYDRAULIC POWER SYSTEM - Disassemble Lift arm shaft

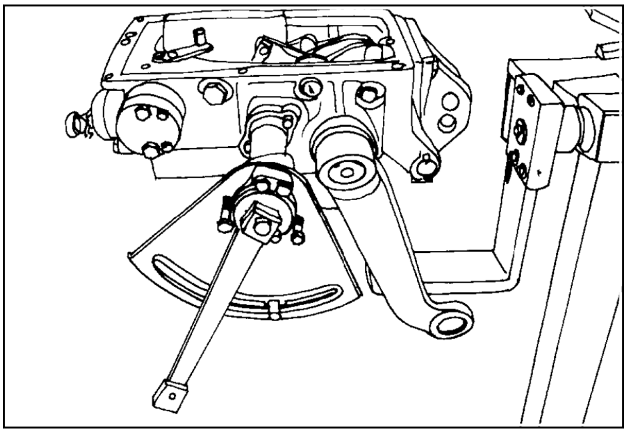
Prior operation:
PRIMARY HYDRAULIC POWER SYSTEM - Remove Mechanical lift assembly (A.10.A)

⚠ WARNING ⚠

Handle all parts carefully. Do not put your hands or fingers between parts. Always wear suitable safety items such as fitted clothing, safety goggles, gloves, shoes, etc. Failure to comply could result in death or serious injury.

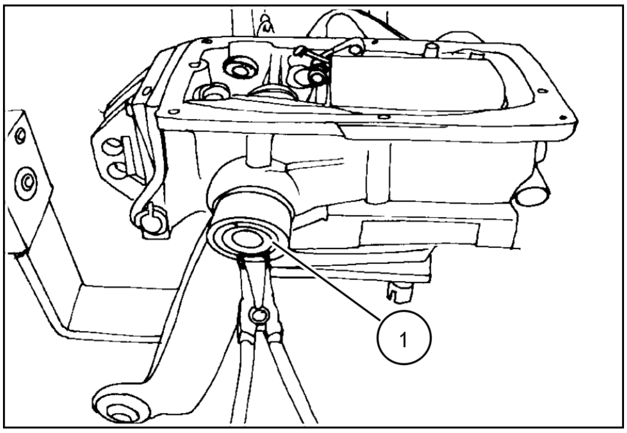
M954A

1. Remove lift assembly from the tractor and install on a rotary stand.



20097475 1

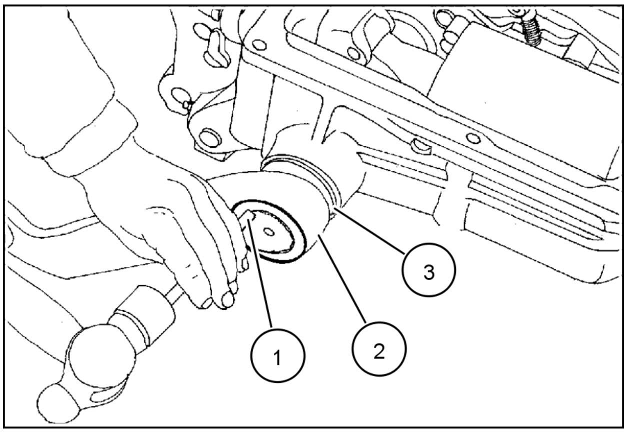
2. Remove the circlip, **(1)**, from lift arm shaft.



20097471 2

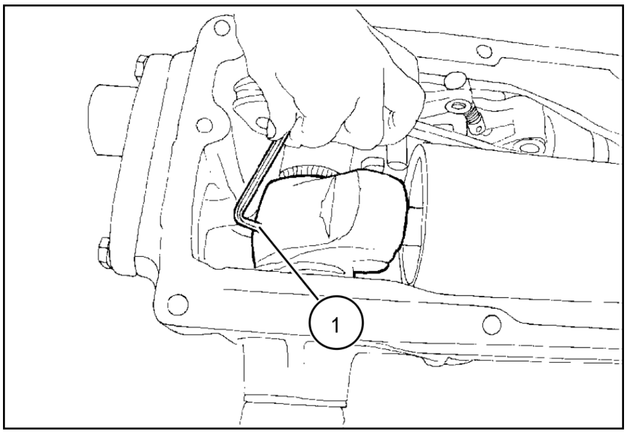
NOTICE: *Before removing lift arm, punch a mark,* ***(1)****, on both lift arm and shaft to facilitate the assembly in original position.*

3. Remove the lift arm, **(2)**, from the shaft.
4. Remove the washer, **(3)**. Repeat the same for the other side lift arm.



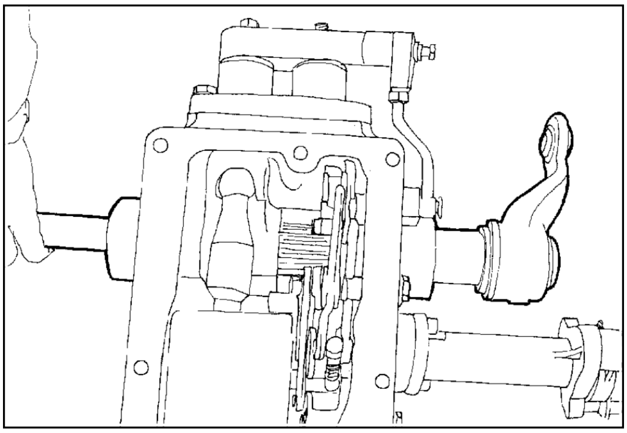
20097470 3

5. Remove the locking screw, **(1)**, securing the crank and shaft.



20097469 4

6. Push the shaft from left side towards right side by hammering gently using aluminum or copper rod



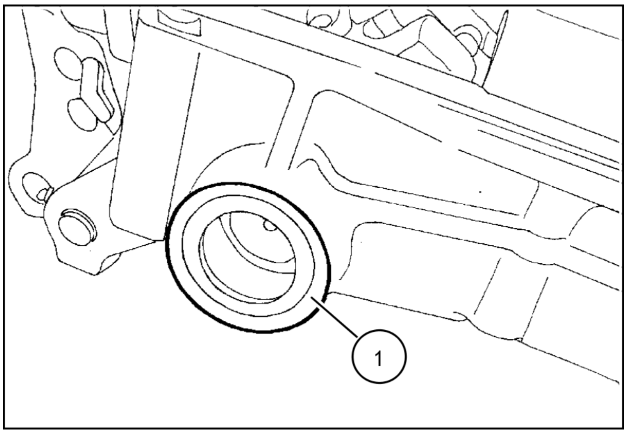
20097468 5

Next operation:
PRIMARY HYDRAULIC POWER SYSTEM - Inspect Lift arm shaft (A.10.A)

PRIMARY HYDRAULIC POWER SYSTEM - Inspect Lift arm shaft

Prior operation:
PRIMARY HYDRAULIC POWER SYSTEM - Disassemble Lift arm shaft (A.10.A)

1. Remove the seals, **(1)**, from the housing.
2. Inspect the bushing for excessive wear and replace as needed. Use a suitable bushing driver to remove and install the bushings.



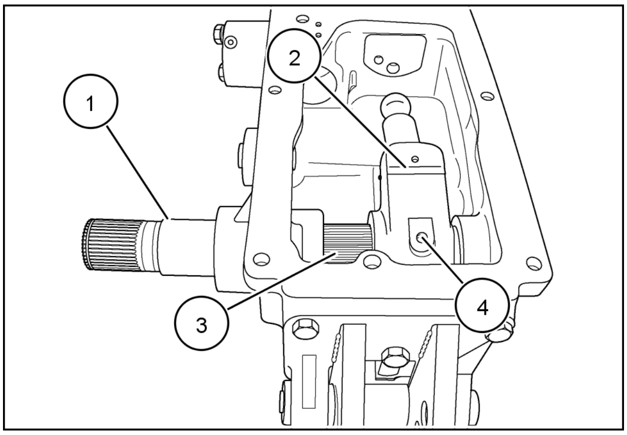
20097467 1

Next operation:
PRIMARY HYDRAULIC POWER SYSTEM - Assemble Lift arm shaft (A.10.A)

PRIMARY HYDRAULIC POWER SYSTEM - Assemble Lift arm shaft

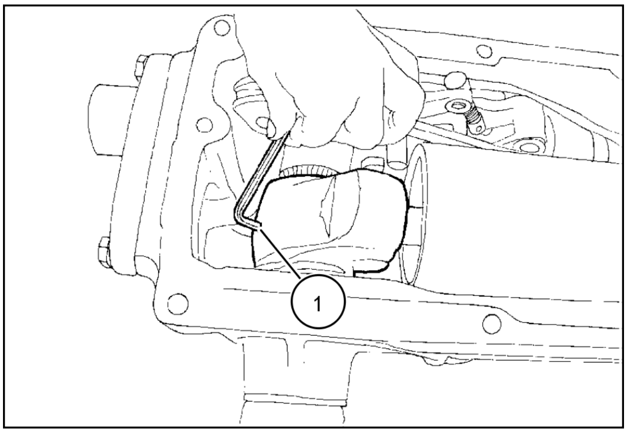
Prior operation:
PRIMARY HYDRAULIC POWER SYSTEM - Inspect Lift arm shaft (A.10.A)

1. Install the shaft, **(1)**, into the housing.
2. Engage the shaft into the crank, **(2)**, and into the other side of the housing.
3. While installing the shaft, make sure to align the hole, **(3)**, in the shaft with the hole, **(4)**, in the crank.



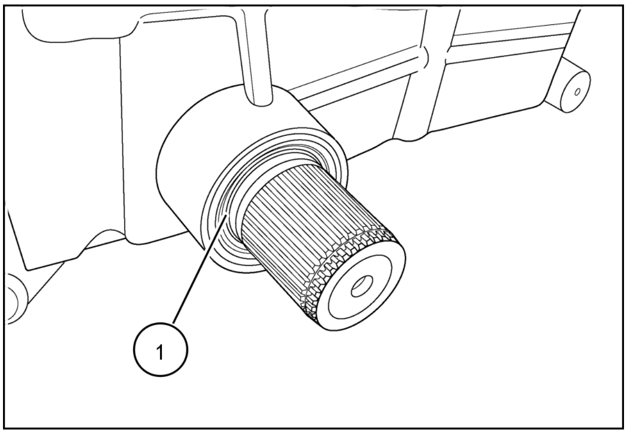
86070611 1

4. Install and secure the locking screw, **(1)**, into the crank.



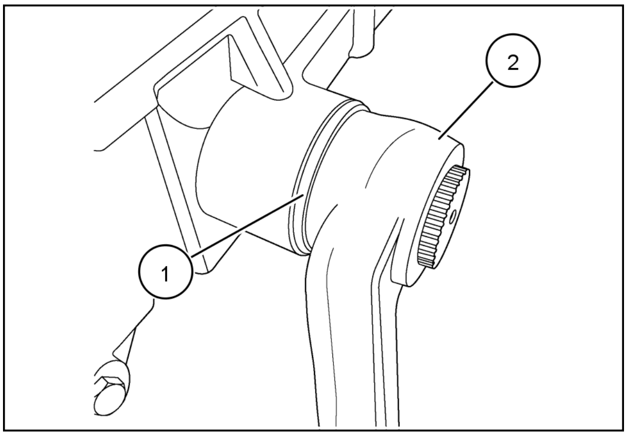
20097469 2

5. Install the seals, **(1)**, into the housing using a suitable seal installer.



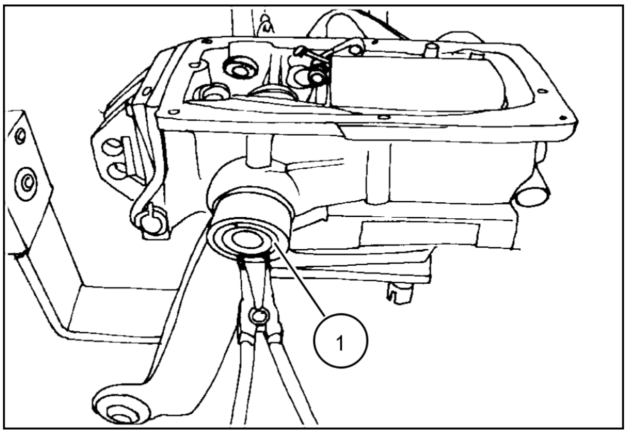
86070612 3

6. Install the washer, **(1)**, onto the shaft.
7. Install the lift arm, **(2)**, onto the shaft making sure to align the marks on the shaft and lift arm.
8. Repeat procedure for other side.



86070613 4

9. Secure both lift arms with snap rings, **(1)**.
10. Remove the hydraulic lift assembly from the rotary stand and install on the tractor using a suitable hoist. Refer to **PRIMARY HYDRAULIC POWER SYSTEM - Install (A.10.A)**



20097471 5

PRIMARY HYDRAULIC POWER SYSTEM - Check Hydraulic system pressure check

NOTICE: *Prior to testing, attach the 3 - point hitch to an unmovable object.*

NOTICE: *For safety, chain the front axle down!*

⚠ WARNING ⚠

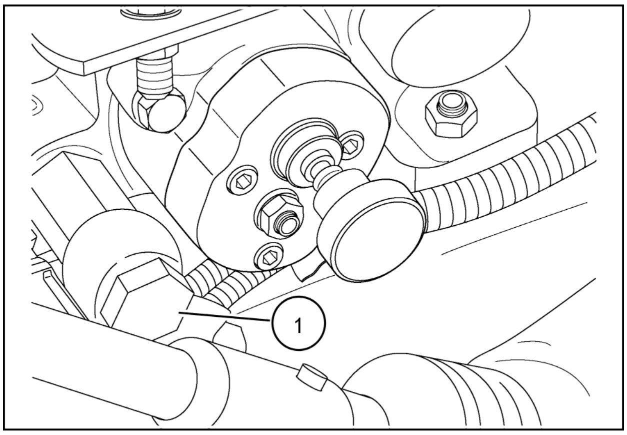
Pressurized hydraulic fluid can penetrate the skin and cause severe injuries. Tighten all of the connections before starting the engine. If hydraulic fluid has penetrated the skin, seek medical assistance immediately. Failure to comply could result in death or serious injury.

M950A

1. Remove banjo fitting, **(1)**, from input line from hydraulic pump.
2. Drill and tap banjo bolt to 1/8" pipe thread.
3. Install adapter fitting into banjo bolt and reinstall on tractor.

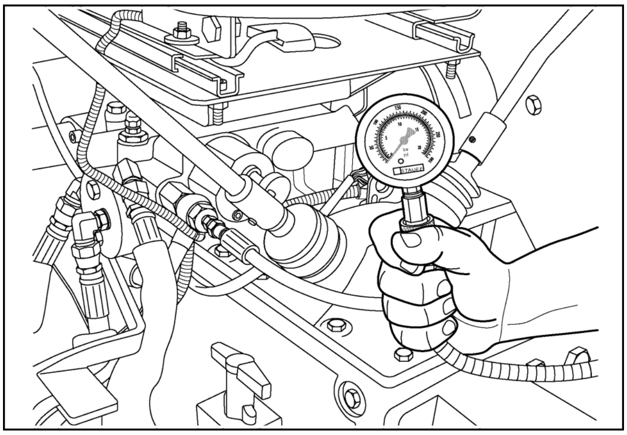
NOTE: *Obtain fitting locally, that will adapt to your test hose and gauge assembly.*

NOTE: *If tractor is equipped with rear remote valve(s) pressure test can be performed at valve quick coupler*



86071999 1

4. Install hose and **3000 psi** rated gauge onto fitting.
5. Start engine and set engine’s rpm at idle.
6. Raise hitch and verify that the gauge reads **17499 - 18002 kPa** (**2538 - 2611 psi**).
7. If the pressure is not within range, proceed to Setting Relief Valve **Relief valve - Pressure test (A.10.A)** .



86072011 2

Relief valve - Pressure test Setting relief valve

⚠ **WARNING** ⚠

Pressurized hydraulic fluid can penetrate the skin and cause severe injuries. Tighten all of the connections before starting the engine. If hydraulic fluid has penetrated the skin, seek medical assistance immediately. Failure to comply could result in death or serious injury.

M950A

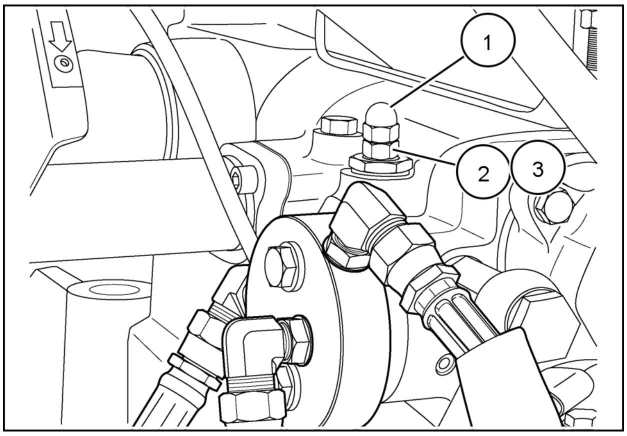
Verify the tractor is turned off and the parking brake is set.

Proceed as follows:

1. Remove acorn nut, **(1)**, from the top of the relief valve assembly.
2. Loosen jam nut, **(2)**, use a **4 mm** octagonal wrench, rotate valve set screw, **(3)**:
   - clockwise to increase pressure
   - counterclockwise to decrease pressure

NOTE: *½ of turn of set screw, changes relief valve setting* ***1379 kPa*** *(**200 psi**).*

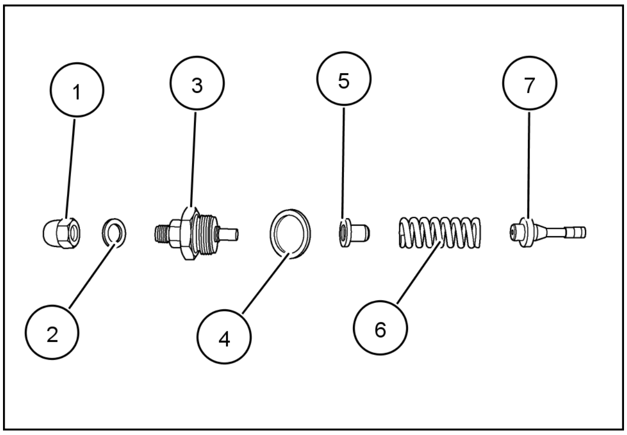
3. Recheck pressure setting, if within specification, tighten jam nut, **(2)**, and reinstall acorn nut, **(1)**, onto relief valve.



86072008 1

Servicing Faulty Relief Valve

4. Remove the relief valve assembly from the tractor
5. Disassemble relief valve .
6. Inspect and clean components, replace any damaged components as needed.
7. Reassemble relief valve and test pressure setting described earlier in this section.



86072012 2

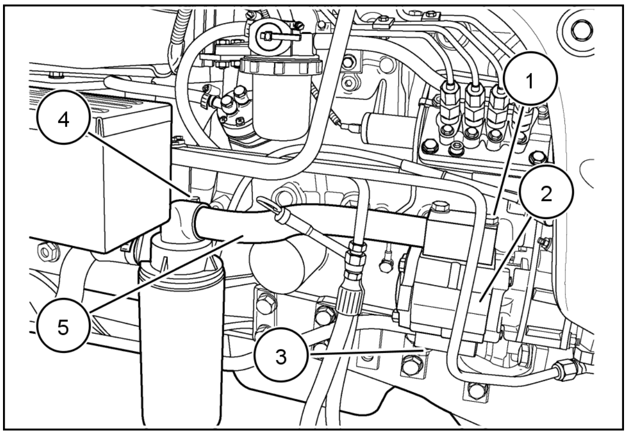
1. Acorn nut
2. Small sealing washer
3. Valve adjuster
4. Large sealing washer
5. Adjuster spring seat
6. Spring
7. Valve Poppet

Hydraulic pump - Remove

NOTE: *The only parts serviced on the hydraulic pump are the shaft seal and internal O-rings. If troubleshooting indicates a faulty pump, replace the pump with a new assembly.*

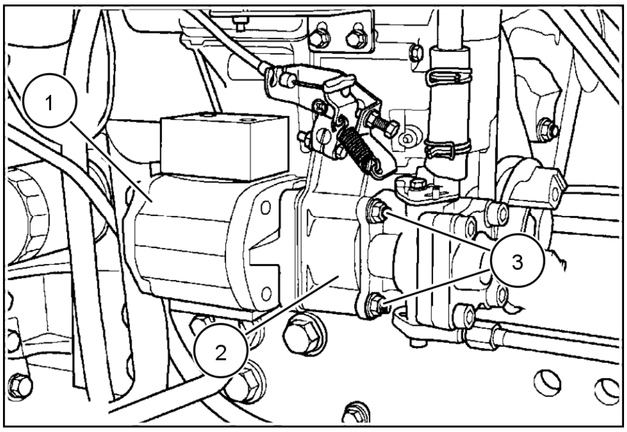
Pump Flow	LPM (GPM)
WORKMASTER 45	**37 l/min** (**9.77 US gpm**)
WORKMASTER 55	**39.8 l/min** (**10.51 US gpm**)

1. Remove the suction tube bolts, **(1)**, from the pump, **(2)**.
2. Remove the high pressure tube bolts, **(3)**, from the pump, **(2)**.
3. Remove the socket head bolts, **(4)**, that retain the pump suction tube **(5)** to the top of the filter base. Remove the suction tube **(5)** from the tractor.



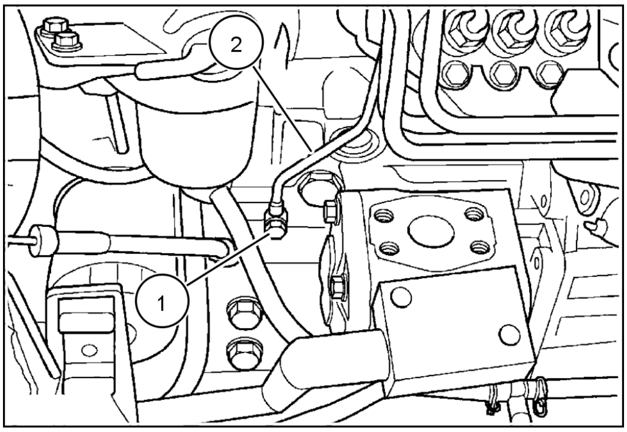
86065627 1

4. Remove the pump mounting bolts and nuts, **(3)**, securing the pump, **(1)**, to the mounting flange, **(2)**.



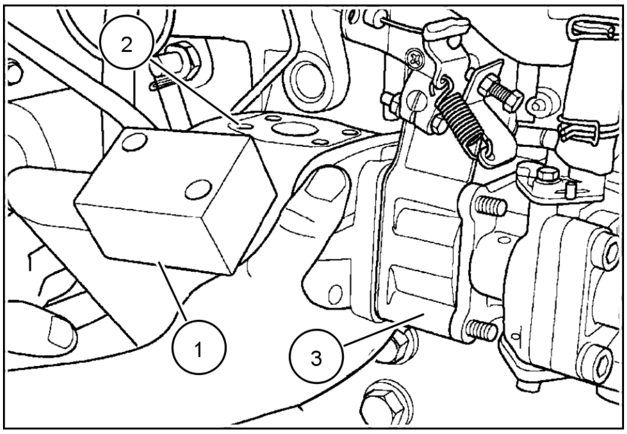
20097491 2

5. Remove the banjo bolt, **(1)** securing the oil line, **(2)**, to the engine block.



20097490 3

6. Remove the suction tube, **(1)**, before removing the pump, **(2)**, from the front mounting flange, **(3)**.

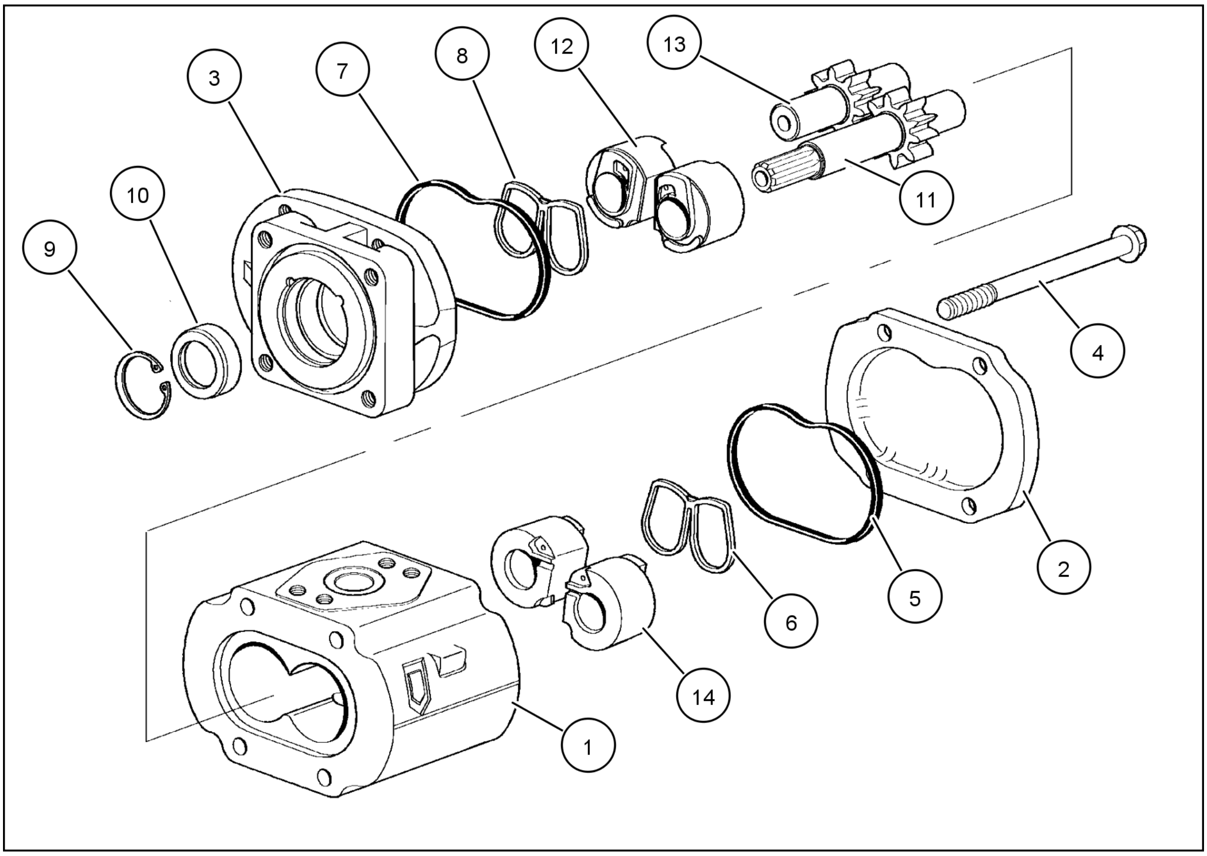


20097489 4

Next operation:
Hydraulic pump - Disassemble (A.10.A)

Hydraulic pump - Disassemble

Prior operation:
Hydraulic pump - Remove (A.10.A)



20097488 1

1. Scribe lines in the pump body, **(1)**, and end covers, **(2)** and **(3)**, for ease of assembly.
2. Remove the bolts, **(4)**, that secure the covers, **(2)** and **(3)**, to the body.
3. Remove the rear cover, **(2)**, from the pump body, **(1)**.
4. Remove the rubber seal ring, **(5)**, and the back up ring, **(6)**.
5. Remove the front cover, **(3)**, from the pump body, **(1)**.
6. Remove the rubber seal ring, **(7)**, and the back up ring, **(8)**.
7. Using snap ring pliers, remove the snap ring, **(9)**.
8. Remove the shaft seal, **(10)**, from the front cover, **(3)**.

NOTE: *The front wear blocks, **(12)**, will come out with the drive shaft, **(11)**. Be sure to note the location of each wear block, as they are each different.*

9. Using a brass drift and hammer, tap the rear of the pump drive shaft, **(11)**, and remove the drive shaft from the pump body.
10. Using a brass drift and hammer, tap the rear of the pump gear, **(13)**, and remove the pump gear from the pump body, **(1)**.

11. Using a brass drift and hammer, remove the rear wear blocks, **(14)**, noting the orientation of each, for ease of assembly.

Next operation:
Hydraulic pump - Inspect (A.10.A)

Hydraulic pump - Inspect

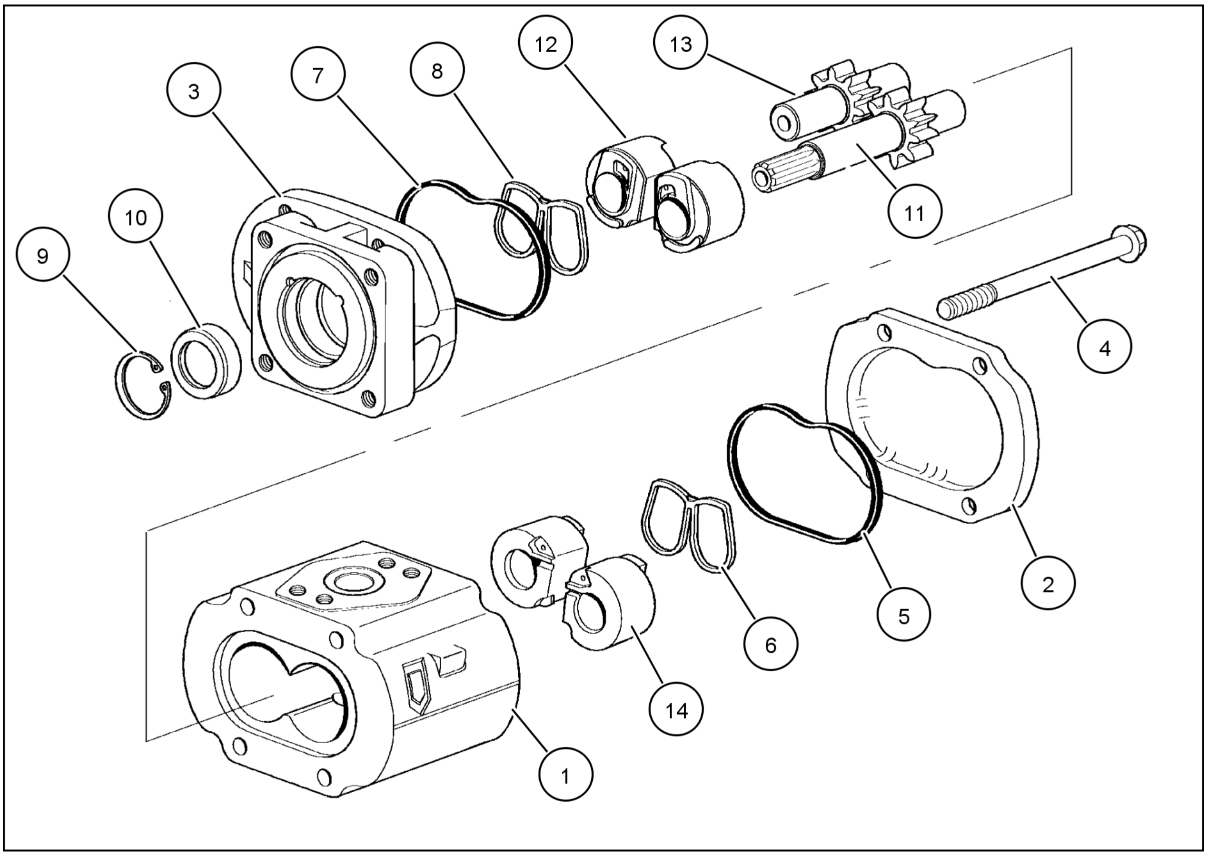
Prior operation:
Hydraulic pump - Disassemble (A.10.A)

1. Wash all parts in clean solvent and air dry.
2. Discard all seals and back up rings.
3. Inspect the gears, wear blocks, and pump bore for excess wear and scoring. If necessary, replace the pump.

Next operation:
Hydraulic pump - Assemble (A.10.A)

Hydraulic pump - Assemble

Prior operation:
Hydraulic pump - Inspect (A.10.A)



20097488 1

1. Lubricate all parts during assembly with clean hydraulic fluid.
2. Place the rear wear blocks, **(14)**, into the pump body, **(1)**. Be sure that the blocks are oriented correctly.
3. Install the pump gear, **(13)**, into the pump body, **(1)**.
4. Install the drive shaft, **(11)**, in to the pump body, **(1)**.
5. Place the front wear blocks, **(12)**, into the pump body, **(1)**. Again, be sure that the blocks are oriented correctly.
6. Using a seal driver, install a new shaft seal, **(10)**, into the front cover, **(3)**.
7. Install the snap ring, **(9)**, into the end of the front cover, **(3)**.
8. Install the new back up rings, **(6)**, **(8)**, and seal rings, **(5)**, **(7)**.
9. Carefully place the front cover, **(3)**, and the rear cover, **(2)**, onto the pump body, **(1)**, aligning the scribe marks made previously during disassembly.
10. Secure the covers, **(2)**, **(3)**, to the pump body, **(1)**, with the bolts, **(4)**. Torque the bolts to **22 - 28 N·m** (**16.2 - 20.7 lb ft**).

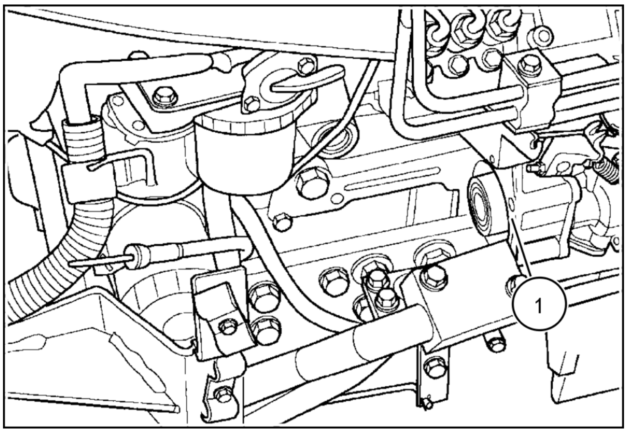
Next operation:

Hydraulic pump - Install (A.10.A)

Hydraulic pump - Install

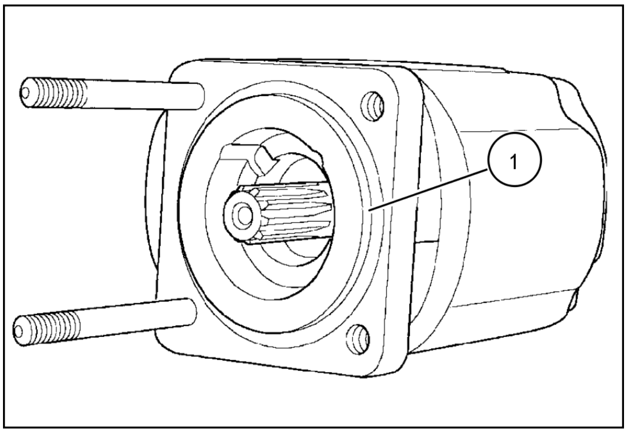
Prior operation:
Hydraulic pump - Assemble (A.10.A)

1. Scrape any remaining O-ring sealant material from the pump mounting flange, **(1)**. Apply a small amount of silicone sealer to the pump mounting flange.



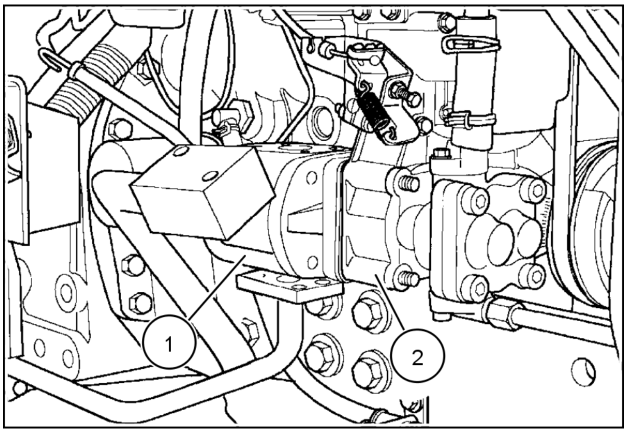
20097487 1

2. Install a new O-ring, **(1)**, on the front cover of the hydraulic pump.



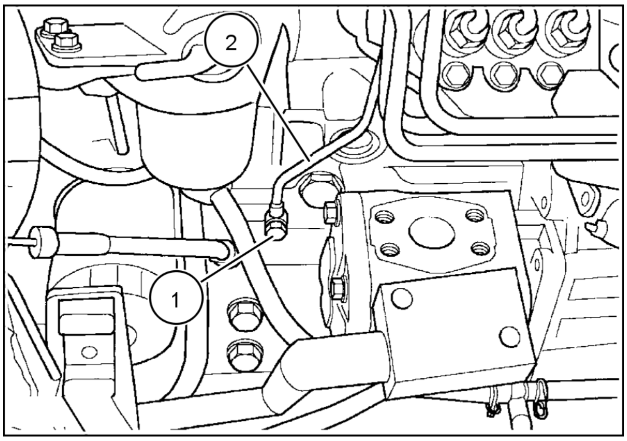
20097486 2

3. Install the pump, **(1)**, onto the pump mounting flange, **(2)**, and secure it with the nuts and bolts.



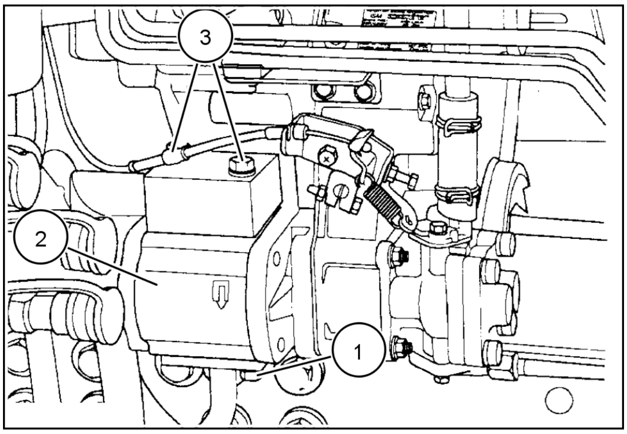
20097485 3

4. Install the banjo bolt, **(1)**, which secures the oil line, **(2)**, to the engine block.



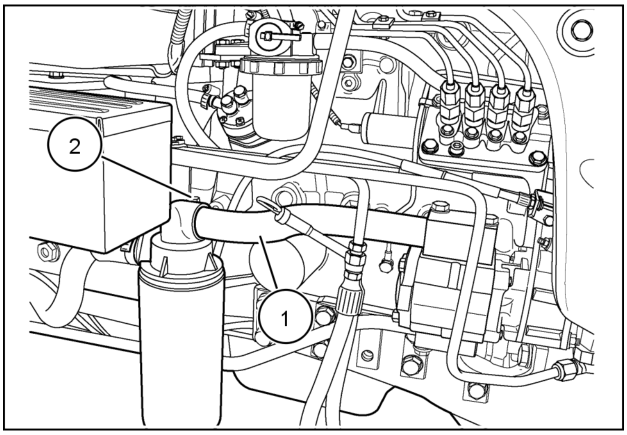
20097484 4

5. Use a new O-ring between the pump and the hydraulic tube and install the M10 flat washers, M10 lock washers, and M10 x 35 cap screws **(1)**, that secure the high pressure tube to the pump, **(2)**. Torque to **44.1 - 55.9 N·m** (**32.5 - 41.2 lb ft**).
6. Use a new O-ring between the pump and the hydraulic tube and install the M10 flat washers and M10 x 55 cap screws, **(3)**, that secure the suction tube to the pump, **(2)**. Torque to **44.1 - 55.9 N·m** (**32.5 - 41.2 lb ft**).



20097483 5

7. Install the suction tube, **(1)**, to the top of the filter base and retain the tube with the M8 x 45 socket head cap screws, **(2)**. Torque to **22.6 - 28.4 N·m** (**16.7 - 20.9 lb ft**).
8. Tighten all nuts and bolts to torque specifications listed in **PRIMARY HYDRAULIC POWER SYSTEM - Torque (A.10.A)**.



86065627 6

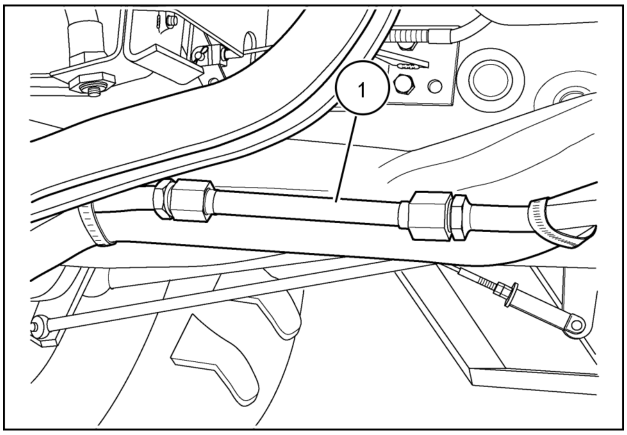
Hydraulic pump - Test

Inlet Restriction Test

Perform the inlet restriction test to check for the hydraulic lines and filter for damage, obstructions, or air leaks. A hydraulic flow meter is required to perform the inlet restriction test.

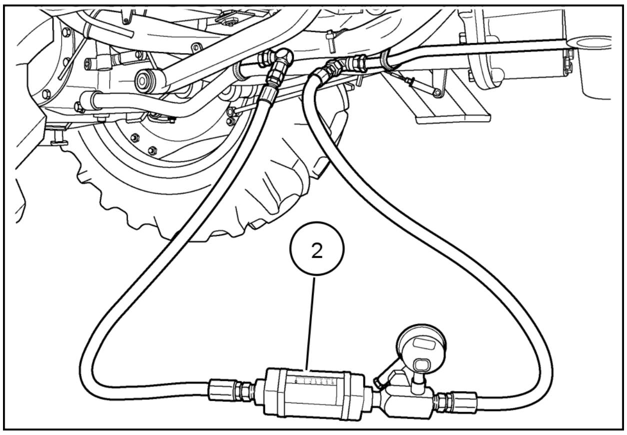
Flow Meter Installation

1. Remove short pipe section, **(1)**, from the pump output hydraulic line.
2. Hydraulic line male fittings are a (-10 JIC) size, procure fittings locally to adapt to your flow meter.



86072013 1

3. Install flow meter, **(2)**, in line, tighten all fittings before starting test!



86072014 2

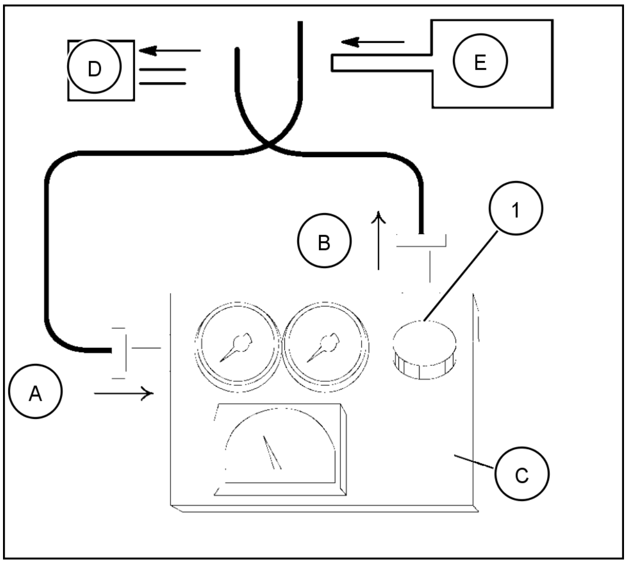
⚠ WARNING ⚠

Pressurized hydraulic fluid can penetrate the skin and cause severe injuries. Tighten all of the connections before starting the engine. If hydraulic fluid has penetrated the skin, seek medical assistance immediately. Failure to comply could result in death or serious injury.

M950A

NOTE: *Inlet restriction test cannot be performed at the rear remote couplers, because of a reduced flow reading.*

1. Start the engine and operate the hydraulic system to warm the hydraulic fluid to normal operating temperature.
2. Open the restrictor valve, **(1)**, to allow full flow through the flow meter.
3. Run the engine at **1427 RPM** (WORKMASTER 45) and **1500 RPM** (WORKMASTER 55) and record the flow meter reading.
4. Run the engine at full throttle [**2855 RPM** (WORKMASTER 45) and **3000 RPM** (WORKMASTER 55)] and read the flow meter. The reading should indicate that the flow has doubled. If the meter reading is low, check the hydraulic lines, and filter for damage, clogs, or air leaks. If there are no problems with the hydraulic lines or the hydraulic filter, the hydraulic pump may require replacement. Use the Pump Efficiency Test described below to further inspect the hydraulic pump.



20097464 3

A - Inlet
B - Return
C - Flowmeter
D - HPL
E - Pump

Pump Efficiency Test

The pump efficiency test measures the hydraulic pump output to determine if the pump is excessively worn or damaged. Perform the pump efficiency test only after the inlet restriction test has been completed. A hydraulic flow meter is required to perform the pump efficiency test.

⚠ **WARNING** ⚠

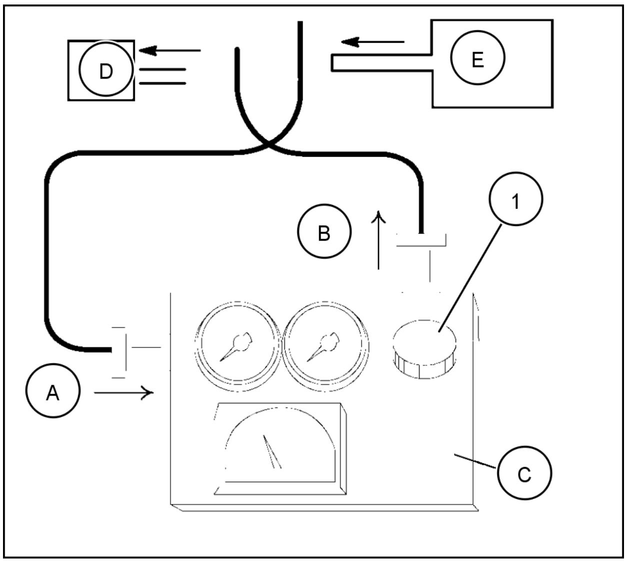
Pressurized hydraulic fluid can penetrate the skin and cause severe injuries. Tighten all of the connections before starting the engine. If hydraulic fluid has penetrated the skin, seek medical assistance immediately. Failure to comply could result in death or serious injury.

M950A

NOTE: *Pump efficiency test cannot be performed at the rear remote couplers, because of a reduced pressure reading.*

5. Start the engine and operate the hydraulic system to warm the hydraulic fluid to normal operating temperature.
6. Operate the tractor engine at full rpm. Observe the flow meter reading. See chart below for the no load pressure readings.
7. Tighten the flow restrictor valve, **(1)**, on the flow meter until the system pressure is **15858 kPa** (**2300 psi**).
8. Observe the flow meter reading, the results should be approximately 80% of the no-load flow.Minimum flow rating is **29.6 l/min** (**7.82 US gpm**) ( ) and **31.84 l/min** (**8.41 US gpm**) ( ). If testing shows the hydraulic pump output is low, the pump requires replacement.

NOTICE: *Do not exceed* ***15858 kPa*** *(****2300 psi****).*



20097464 4

A - Inlet
B - Return
C - Flowmeter
D - HPL
E - Pump

Model		
Pump Capacity	**37 l/min** (**9.8 US gpm**)	**39.8 l/min** (**10.5 US gpm**)
rpm @ half throttle	**1427 RPM**	**1500 RPM**
Pump flow @ half throttle	**18.5 l/min** (**4.9 US gpm**)	**19.9 l/min** (**5.3 US gpm**)
rpm @ full throttle	**2855 RPM**	**3000 RPM**
Pump flow @ full throttle	**37 l/min** (**9.8 US gpm**)	**39.8 l/min** (**10.5 US gpm**)

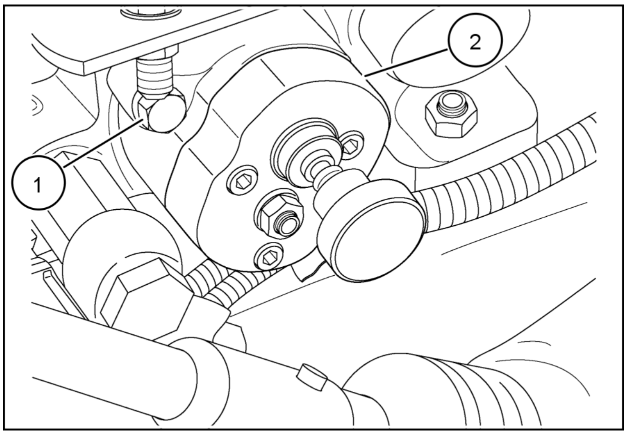
Control valve - Remove

⚠ WARNING ⚠

Handle all parts carefully. Do not put your hands or fingers between parts. Always wear suitable safety items such as fitted clothing, safety goggles, gloves, shoes, etc. Failure to comply could result in death or serious injury.

M954A

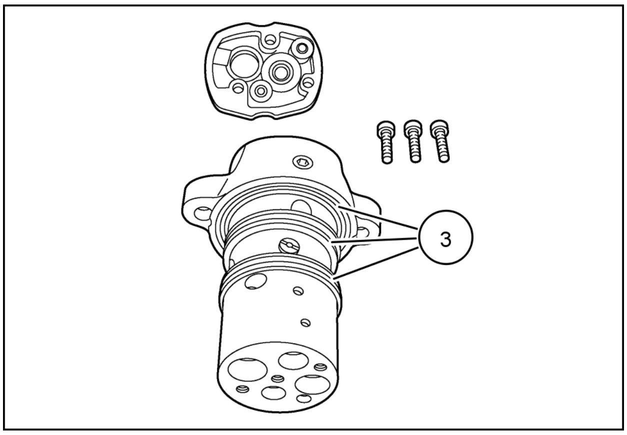
1. Lower the three-point hitch to the ground to relieve any hydraulic pressure in the valve.
2. Remove the mounting bolts, **(1)**, securing the valve assembly, **(2)**, to the front of the hydraulic lift cover.
3. Remove the valve assembly from the lift cover.



86071999 1

4. Inspect the O-rings, **(3)**, on the valve body, replace if damaged

NOTE: *The control valve spool components are not serviced separately but the valve could be disassembled and cleaned if in case of oil contamination.*



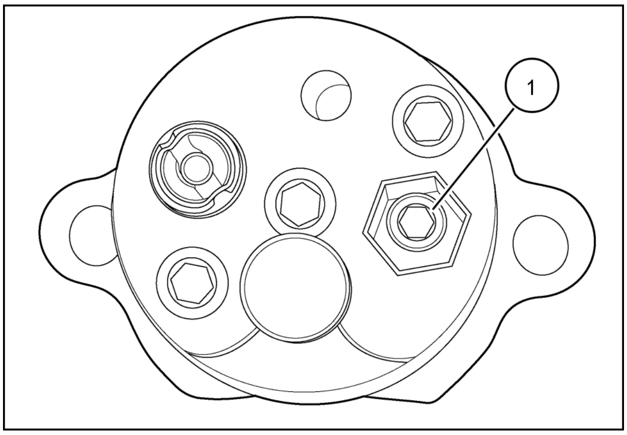
86071997 2

Next operation:
Control valve - Disassemble (A.10.A)

Control valve - Disassemble

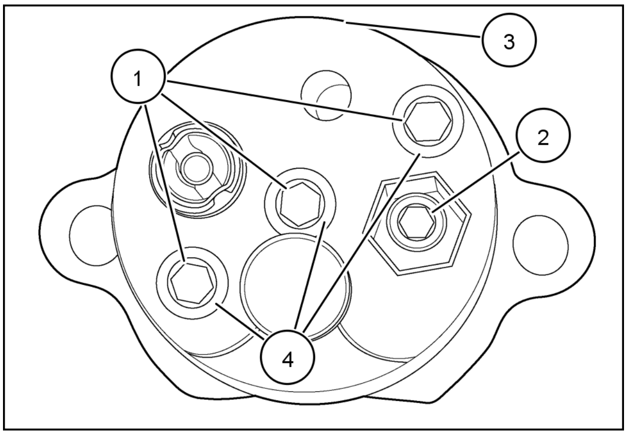
Prior operation:
Control valve - Remove (A.10.A)

NOTICE: *Before disassembling the valve, measure the safety valve screw protrusion, **(1)**, from the rear plate. This screw adjusts the relief pressure of the safety valve.*



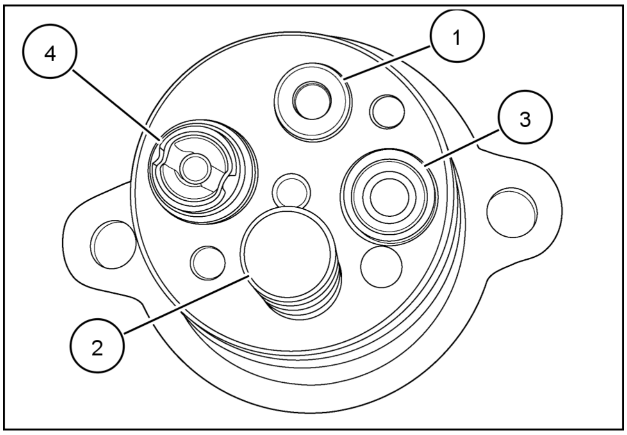
86072000 1

1. Remove the socket head bolts, **(1)**, and safety valve set screw, **(2)**, from the rear of the valve body.
2. Remove the rear plate, **(3)** and three spacers, **(4)**, from the valve body.



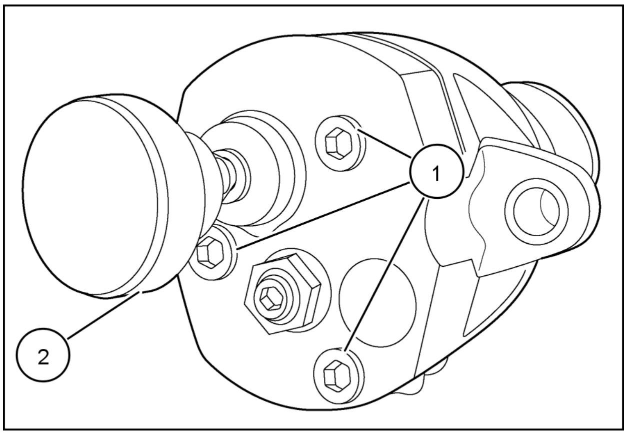
86072000 2

3. Remove the following components from the valve body:
   - Pilot valve **(1)**
   - Control Valve spool **(2)**
   - Safety valve assembly **(3)**
   - Regulator valve assembly **(4)**



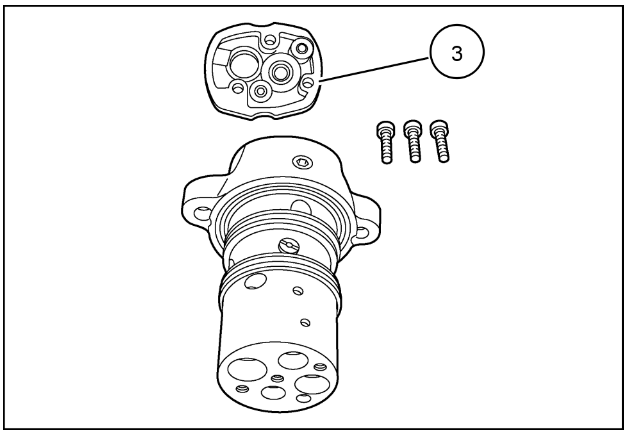
86072001 3

4. Remove the socket head bolts, **(1)**, and lowering response valve knob, **(2)**, from the front of the valve body.



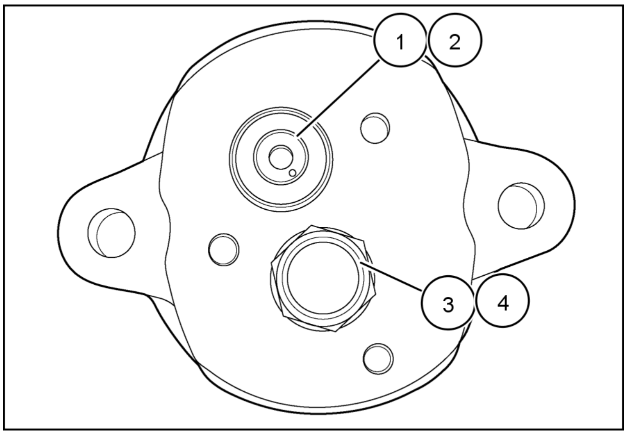
86072002 4

5. Remove the front cap, **(3)**, from the valve body.

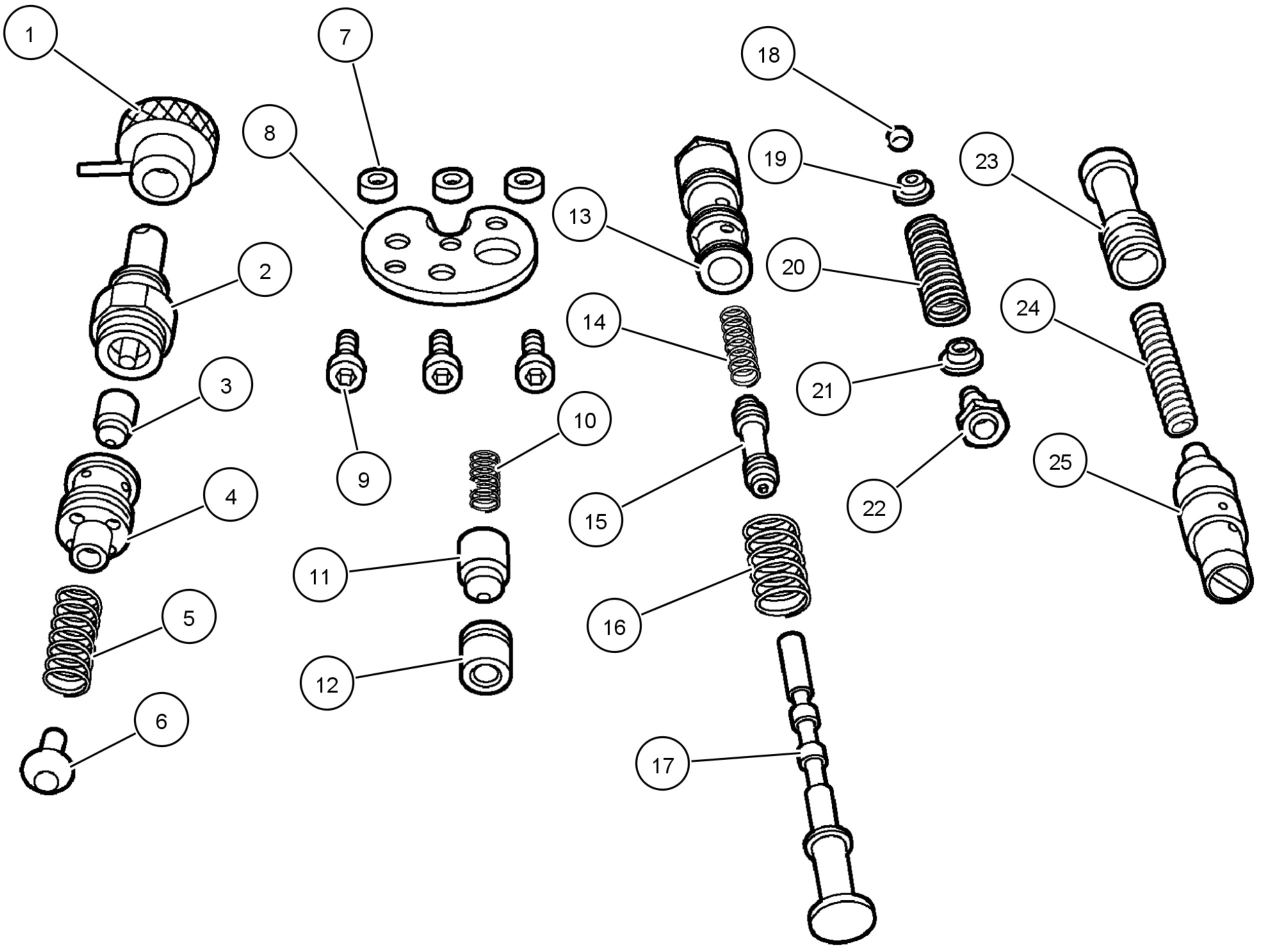


86071997 5

6. Remove the following components from the valve body:
   - Lowering response and lift check valves **(1)** and **(2)**
   - Discharge valve and control valve spool **(3)** and **(4)**



86072003 6



20097466 7

Control Valve Component Breakdown

1.	Lowering response valve knob	14.	Discharge valve spool spring
2.	Lowering response valve adjuster assembly	15.	Inner control valve spool
3.	Lowering response valve poppet	16.	Outer control valve spool spring
4.	Lowering response valve poppet seat	17.	Outer control valve spool
5.	Lift check valve spring	18.	Safety valve ball
6.	Lift Check valve poppet	19.	Safety valve ball seat
7.	Rear end cap spacers	20.	Safety valve spring
8.	Rear End Cap	21.	Safety valve adjuster screw seat
9.	Socket head bolts	22.	Safety valve adjuster screw and lock nut
10.	Pilot valve spring	23.	Regulator valve spool
11.	Pilot valve poppet	24.	Regulator valve spring
12.	Pilot valve poppet seat	25.	Regulator valve
13.	Discharge valve spool		

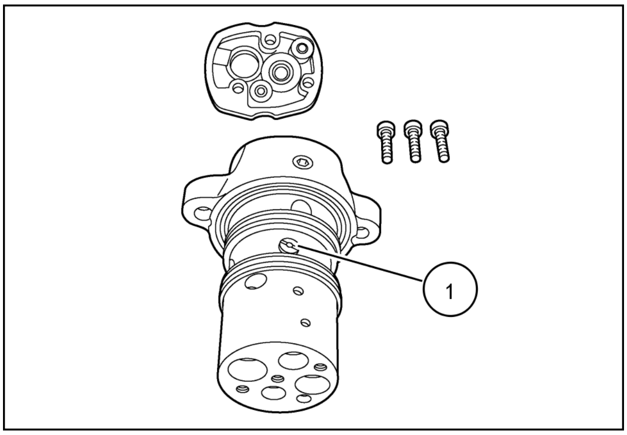
Next operation:
Control valve - Inspect (A.10.A)

Control valve - Inspect

Prior operation:
Control valve - Disassemble (A.10.A)

1. Clean the valve body and components with solvent, check all components for contamination or damage.

NOTE: *Check orifice,* ***(1)****, for contamination.*



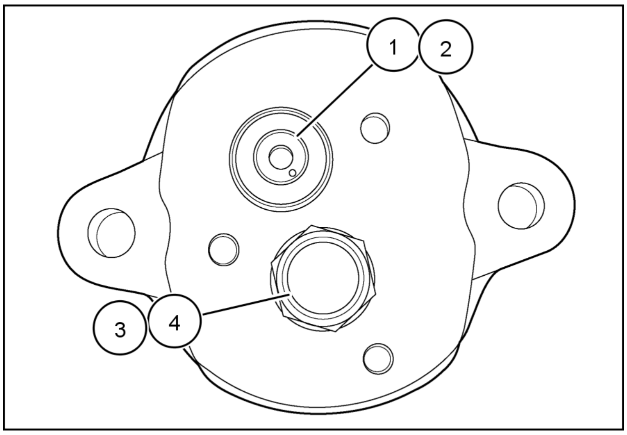
86071997 1

Next operation:
Control valve - Assemble (A.10.A)

Control valve - Assemble

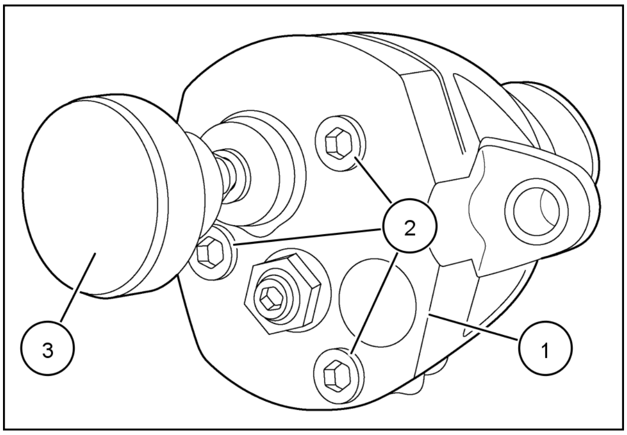
Prior operation:
Control valve - Inspect (A.10.A)

1. Install the following components in the valve body:
    - Lowering response and lift check valves, **(1)**, and, **(2)**.
    - Discharge valve and control valve spool, **(3)**, and **(4)**.



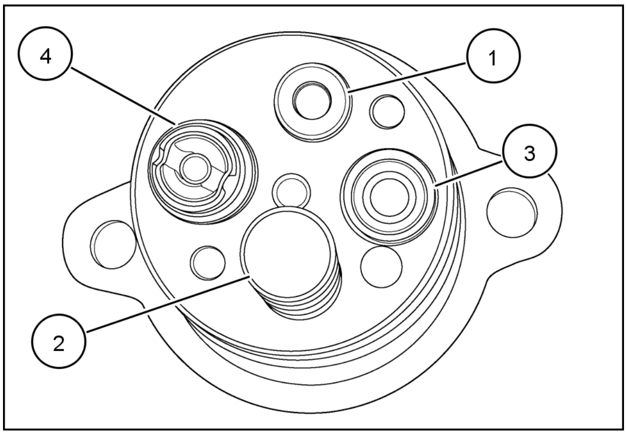
86072003 1

2. Install the front cap, **(1)**, on the valve body. Secure using the three M6 x 25 socket head cap screws, **(2)**.
3. Install the lowering response valve knob, **(3)**, on the valve body.



86072002 2

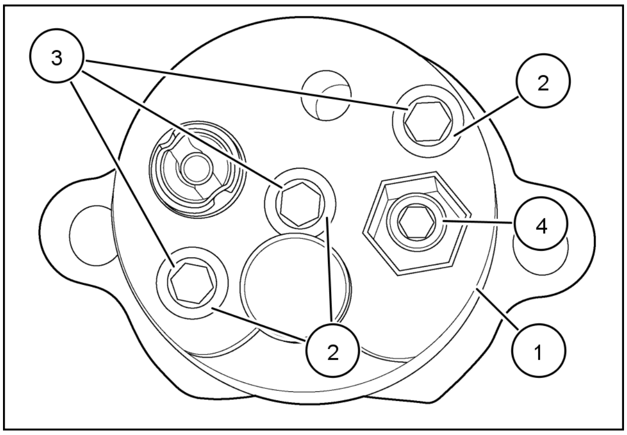
4. Install the following components in the valve body:
    - Pilot valve **(1)**
    - Control valve spool **(2)**
    - Safety valve assembly **(3)**
    - Regulator valve assembly **(4)**



86072001 3

5. Install the rear plate, **(1)**, and three spacers, **(2)**, on the valve body.
6. Secure the rear of the valve body using the three M6 socket head cap screws, **(3)**, and safety valve set screw, **(4)**.

NOTICE: *Set the safety valve set screw, to the measured protrusion height obtained during disassembly.*



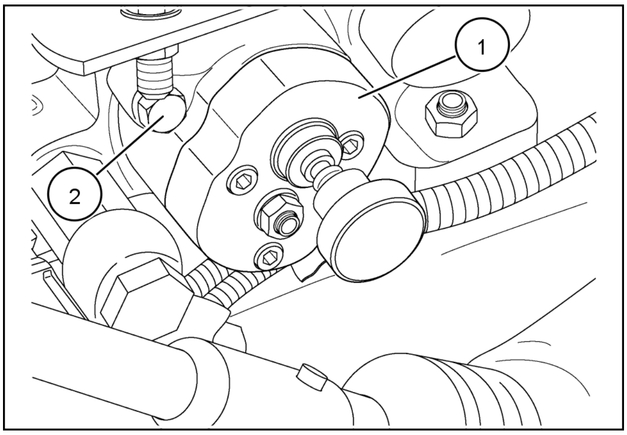
86072000 4

Next operation:
Control valve - Install (A.10.A)

Control valve - Install

Prior operation:
Control valve - Assemble (A.10.A)

1. Insert the valve assembly, **(1)** into the lift cover.
2. Secure the valve assembly, **(1)**, using the two M8 lock washers, and two M8 x 35 cap screws, **(2)**.



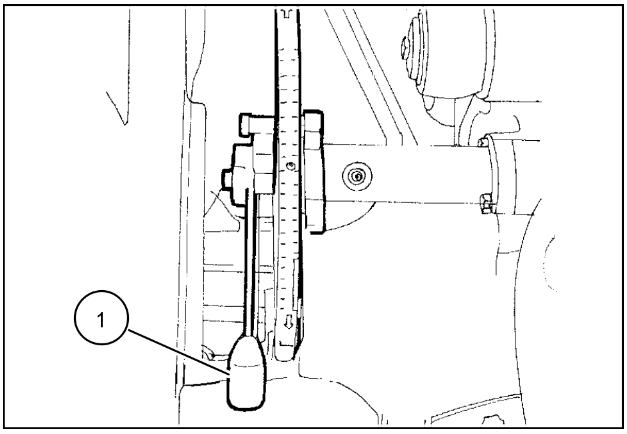
86071999 1

Next operation:
Control valve - Adjust Sensitivity adjustment (A.10.A)

Control valve - Adjust Sensitivity adjustment

Prior operation:
Control valve - Install (A.10.A)

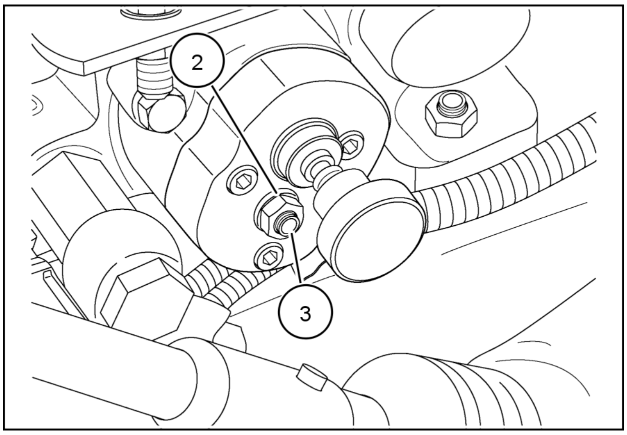
1. Apply a load to the tractor rear lift arms. Set the park brake and place both transmission levers in neutral. Start the tractor and set throttle at 1/3 throttle position. Move the position control lever, **(1)**, upwards to middle of control quadrant.



20097494 1

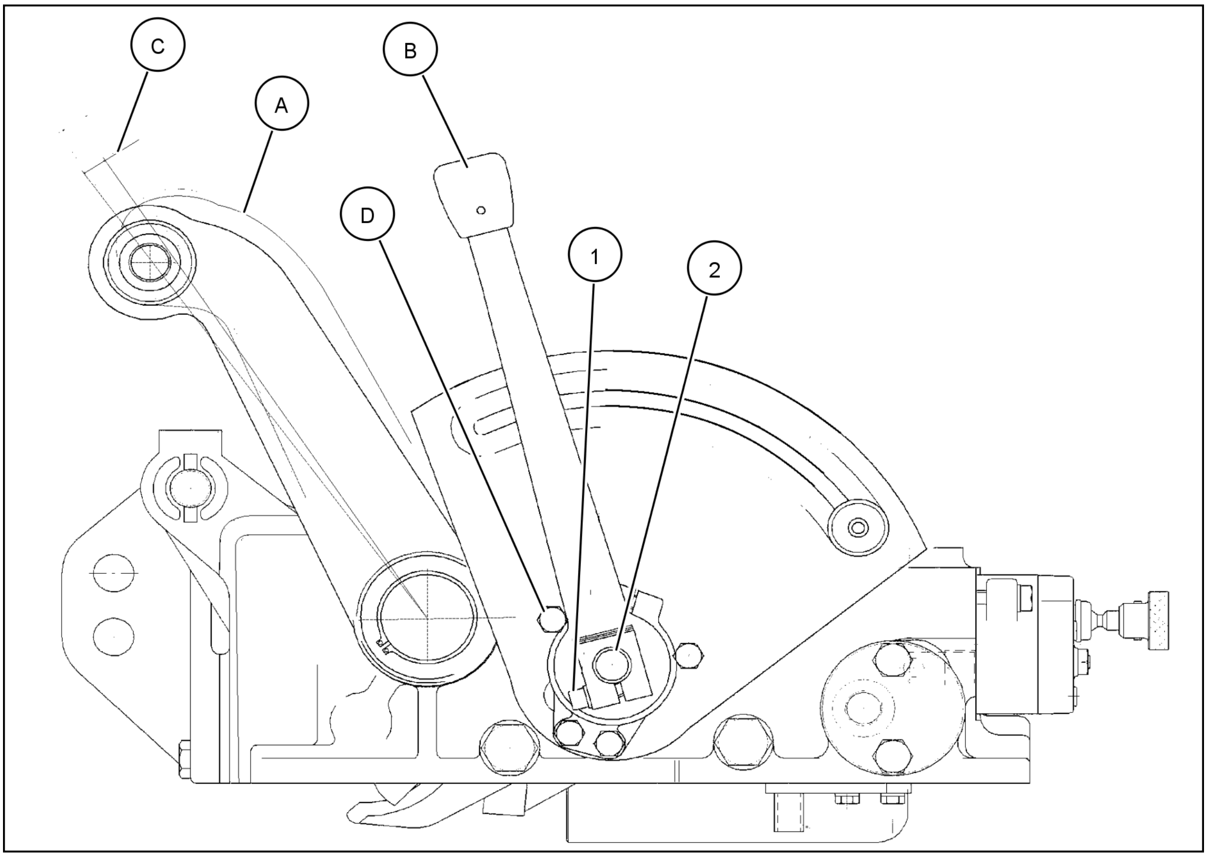
NOTE: *Control valve head viewed from the front of the tractor.*

2. Loosen the lock nut, **(2)**.
3. Using a **4 mm** hexagonal wrench, rotate the screw, **(3)**, in a clockwise direction until the lift arms start to cycle up and down. Then rotate screw, **(3)**, in a counterclockwise direction until the arms stop cycling.
4. Once the arms stop cycling, rotate screw, **(3)**, an additional ½ to ¾ of a turn counterclockwise and lock in position with lock nut, **(2)**.



86071999 2

Control valve - Adjust Position control lever adjustment



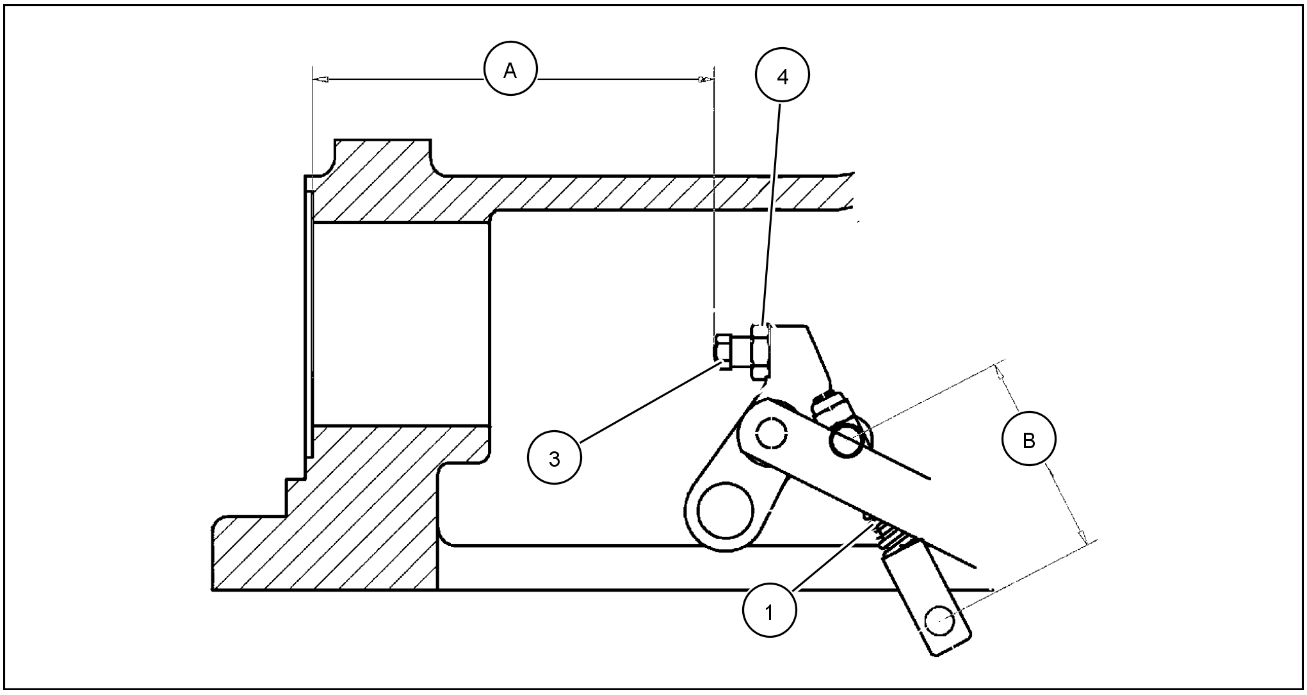
20097478 1

A. Hydraulic lift arm at the end of stroke
B. Lever
C. **10 - 15 mm** (**0.39 - 0.59 in**)

This adjustment will set the maximum raised position of the rear lift arms.

1. Completely lower the lift arms and apply a light weight to the arms.
2. Loosen the retaining socket head cap screw, **(1)**, so that the position lever, **(B)**, is loose on the shaft, **(2)**.
3. Move the position control lever, **(B)**, rearward against rear stop **(D)**.
4. While keeping the position control lever, **(B)**, fixed against rear stop **(D)**, slowly rotate control shaft, **(2)**, counterclockwise, using a **13 mm** wrench, until the rear lift arms are raised to the maximum lift position, which is determined by the internal hydraulic limit stop.
5. When the rear lift arms are at the maximum lift position, the internal limit stop must not be triggered. To not trigger the internal safety stop, the rear lift arms must have **10 - 15 mm** (**0.39 - 0.59 in**) of free play at the top of their travel.
6. To set this free play, rotate shaft, **(2)**, clockwise until the arms are lowered **10 - 15 mm** (**0.39 - 0.59 in**) from the maximum lift position.
7. When the proper free play amount, **10 - 15 mm** (**0.39 - 0.59 in**) is obtained, fix shaft, **(2)**, in position with the position lever, **(B)**, against the rear stop **(D)**. Tighten retaining bolt, **(1)**, to retain the lever to the shaft.
8. To check adjustment, raise lever, **(B)**, against rear stop **(D)**, with the rear lift arms at top of travel **(A)** there should be **10 - 15 mm** (**0.39 - 0.59 in**) of free play in the arms **(C)**.

Control valve - Adjust Internal push rod adjustment

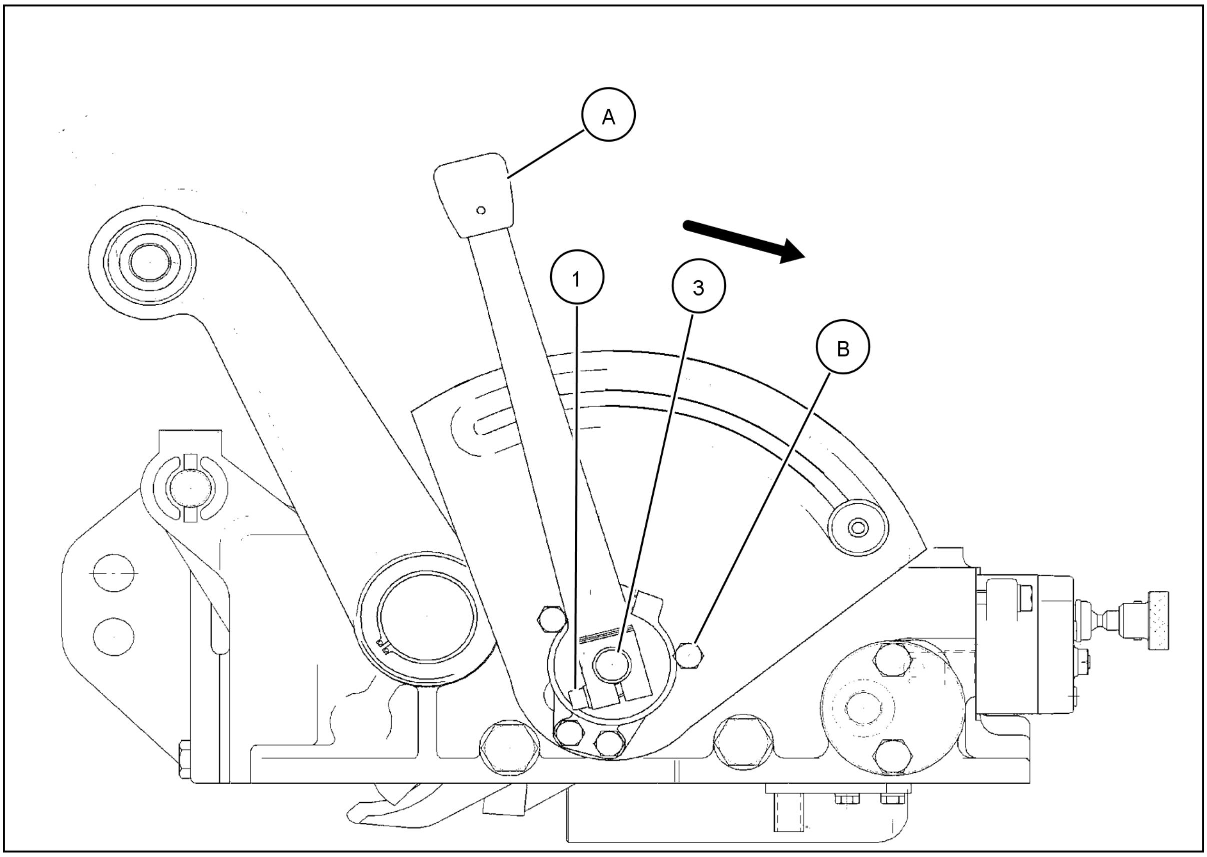


20097465 1

A. **112 - 112.5 mm** (**4.41 - 4.43 in**)
B. **54.8 - 55 mm** (**2.16 - 2.17 in**)

NOTE: *Before adjusting internal push rod, the control valve sensitivity and position lever adjustments must be completed.*

1. Adjust the internal linkage spring, **(1)**, to, **54.8 - 55 mm** (**2.16 - 2.17 in**).This measurement is center of pin to center of pin.



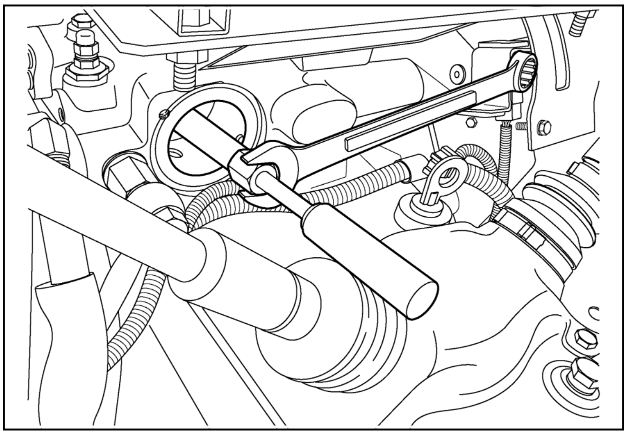
20097478 2

A. Lever

2. With the rear lift arms lowered and without any load on arms, place the position lever, **(A)**, to its lower position with lever against backstop **(B)**.

3. Push the end of the push rod, **(3)** Figure **1**, rearward, removing any free play, and measure from the end of the push rod to the outer mounting surface of the control valve opening. The measurement should be **112 - 112.5 mm** (**4.41 - 4.43 in**).

4. If the push rod measurement is not correct, use socket tool **380002811** to loosen locknut, **(4)** Figure **1**, and rotate push rod, **(3)**, as needed to obtain proper measurement. Tighten locknut, **(4)** when measurement is obtained.



86072010 3

PRIMARY HYDRAULIC POWER SYSTEM - Troubleshooting

Problem	Possible Cause	Correction
Lift arms lift jerky	Hydraulic oil level low	Add hydraulic oil to correct level
	Suction Filter is clogged	Replace oil filter
	Pump has an air suction leak	Check all inlet pipe connections
Lift arms do not lift	Inner control valve spool not shifting to open position	Remove control valve and clean spool
	Regulator valve not shifting	Remove and clean regulator valve
Lift arms do not lower	Discharge valve blocked	Remove discharge valve and clean
	Lowering response valve closed	Open lowering response valve by turning counterclockwise
Lift arms do not lower full travel	Incorrect adjustment of the position control lever	Adjust position control lever
	Control valve sensitivity adjustment not adjusted correctly	Adjust control valve sensitivity
Low lift capacity	Damaged control valve outer diameter O-rings	Replace O-rings as necessary
	Relief valve not adjusted correctly	Adjust relief valve to specification
	Worn lift cylinder piston seal	Replace damaged seal
Lift arms cycle up and down with load applied with engine running	Lift cylinder piston seal damaged	Replace piston seal
	Discharge valve not adjusted correctly	Adjust sensitivity of control valve
	Lift check valve not seating properly	Inspect lift check valve for contamination
	Safety valve not seating properly	Inspect safety valve for contamination
Lift arms leak down when engine is not running	Lift cylinder piston seal damaged	Replace piston seal
	Discharge valve not adjusted correctly	Adjust sensitivity of control valve
	Lift check valve not seating properly	Inspect lift check valve for contamination
	Safety valve not seating properly	Inspect safety valve for contamination
When lift arms are at maximum lift height, with the engine running, the lift arms cycle up and down	Position control lever maximum height position not adjusted correctly	Adjust position control lever maximum position setting

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PRIMARY HYDRAULIC POWER SYSTEM Open center mechanical remote valve - 10.D

Workmaster 45
Workmaster 55

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HYDRAULIC - PNEUMATIC - ELECTRICAL - ELECTRONIC SYSTEMS - A

PRIMARY HYDRAULIC POWER SYSTEM Open center mechanical remote valve - 10.D

SERVICE

Command

Disassemble Rear lift external controls 3

Assemble Rear lift external controls 5

Command - Disassemble Rear lift external controls

Prior operation:
PRIMARY HYDRAULIC POWER SYSTEM - Remove Mechanical lift assembly (A.10.A)

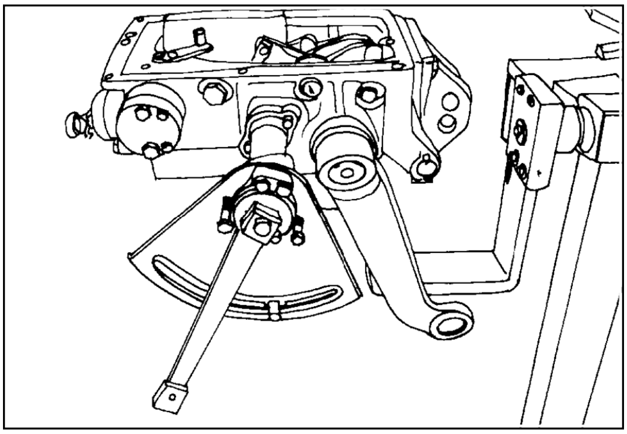
⚠ **WARNING** ⚠

Handle all parts carefully. Do not put your hands or fingers between parts. Always wear suitable safety items such as fitted clothing, safety goggles, gloves, shoes, etc. Failure to comply could result in death or serious injury.

M954A

Lift external control can be disassembled and reassembled only with the lift on a work bench or on a rotary stand. With the lift on the tractor only position control lever can be removed.
Proceed as follows:

1. Remove the hydraulic lift from the transmission housing and place on a work bench or fix on a rotary stand.



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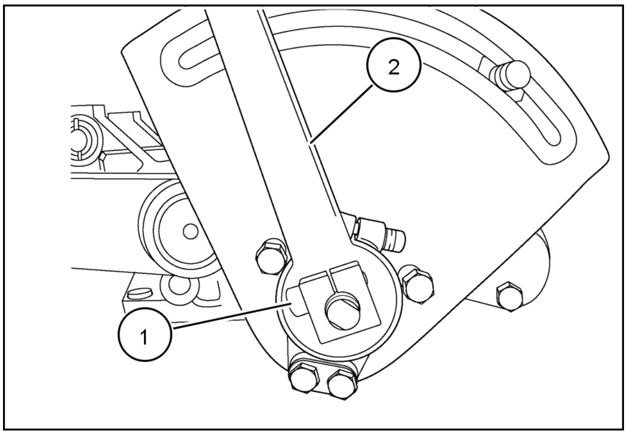
2. Remove the socket head cap screw, **(1)**, and pull out the position control lever, **(2)**.



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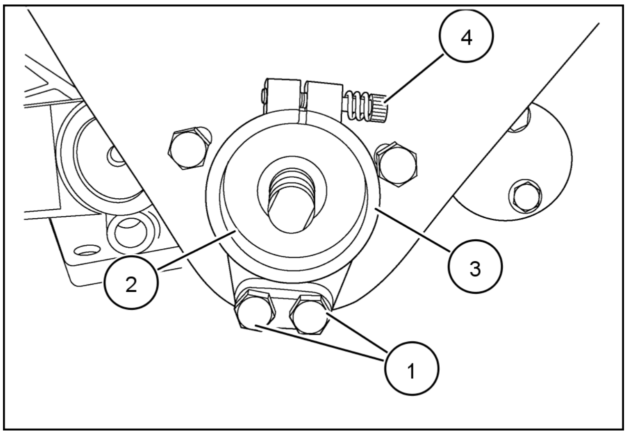
3. Remove bolts, **(1)**, and remove position control lever hub, **(2)**, along with nylon washer, **(3)**.

NOTE: *Nylon washers, **(3)**, can be removed from the hub by loosening socket head cap screw, **(4)**.*



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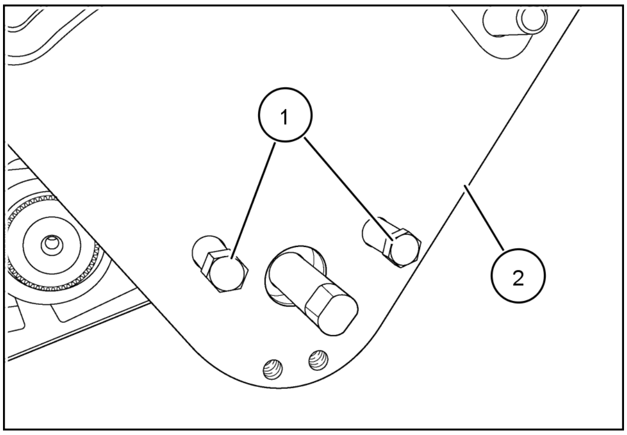
4. Remove the bolts, **(1)**, and remove sector plate, **(2)**.



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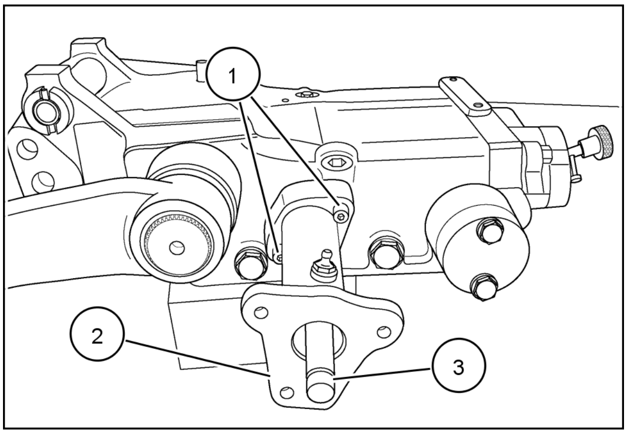
5. Remove the socket head cap screws, **(1)**, and remove the shaft cover, **(2)**.
6. Inspect the shaft, **(3)**, for wear and service as needed.

NOTE: *To remove the shaft, refer to* ***PRIMARY HYDRAULIC POWER SYSTEM - Disassemble (A.10.A)****.*



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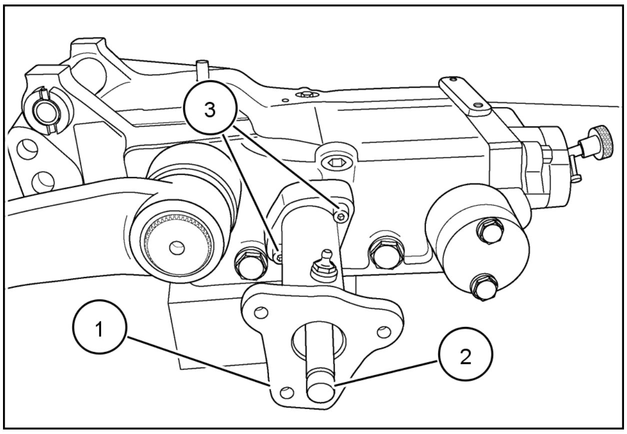
Next operation:
Command - Assemble Rear lift external controls (A.10.D)

Command - Assemble Rear lift external controls

Prior operation:
Command - Disassemble Rear lift external controls (A.10.D)

1. Install the cover, **(1)**, over the shaft, **(2)**.
2. Secure the cover to the hydraulic lift housing with socket head cap screws, **(3)**, from removal.



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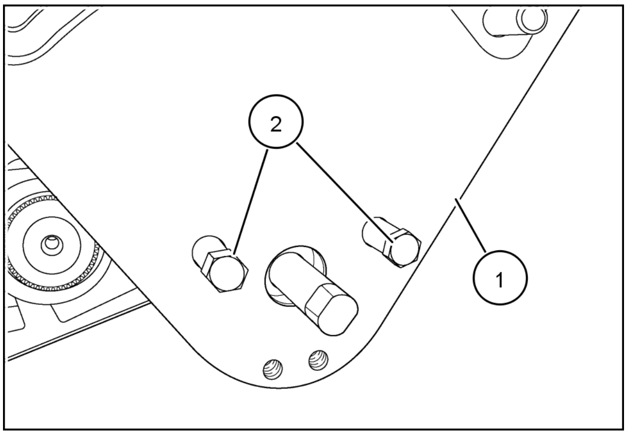
3. Install the sector plate, **(1)**, and secure with bolt and spacer, **(2)**.



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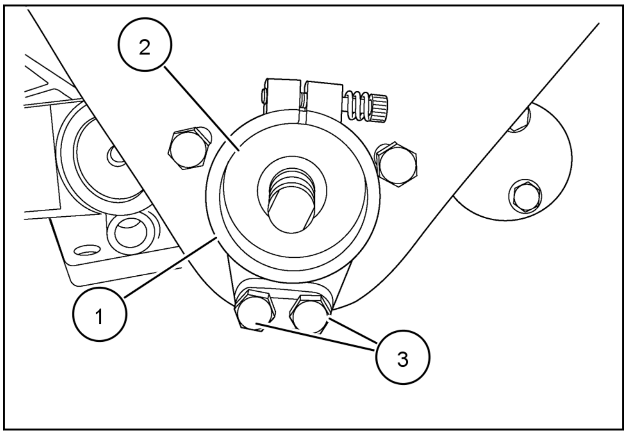
4. Install the position control hub, **(1)**, with nylon washer, **(2)**.
5. Secure the hub to the housing with bolts, **(3)**, from removal.



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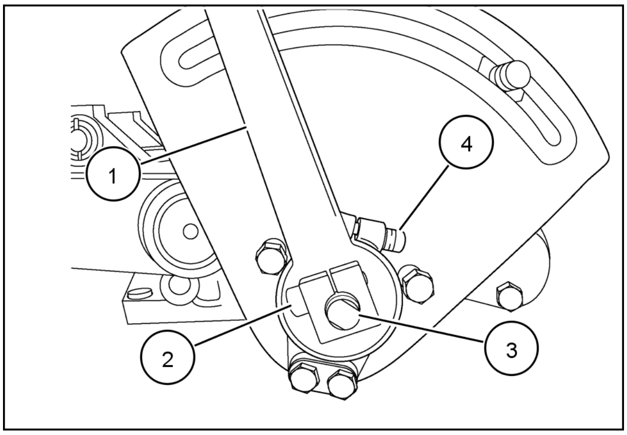
6. Install the position control lever, **(1)**, into the hub.
7. Before installing the socket head cap screw, **(2)**, turn the shaft, **(3)**, fully forward.
8. Secure the lever socket head cap screw, **(2)**, and hub socket head cap screw, **(4)**.
9. Reinstall the hydraulic lift onto the transmission housing. Refer to **PRIMARY HYDRAULIC POWER SYSTEM - Install Mechanical lift assembly (A.10.A)**.



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HYDRAULIC - PNEUMATIC - ELECTRICAL - ELECTRONIC SYSTEMS - A

HYDRAULIC COMMAND SYSTEM - 14.A

Workmaster 45
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HYDRAULIC COMMAND SYSTEM - 14.A

SERVICE

Hydraulic pump

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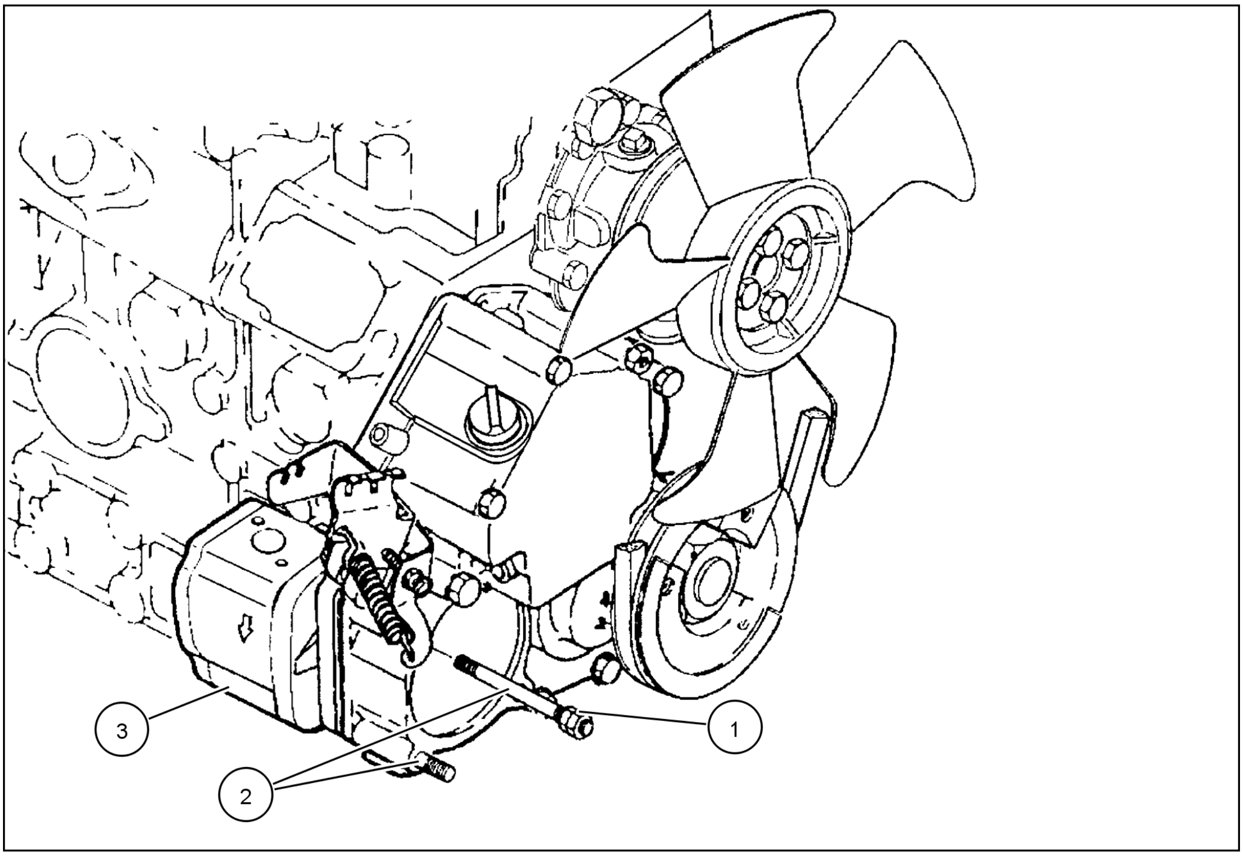
Hydraulic pump - Install Engine mounted

Prior operation:
Fuel injection pump - Install (B.20.A).



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1. Mount the hydraulic oil pump **(3)**, on the timing case cover, and install the retaining studs **(2)**.
2. Remove the two nuts **(1)**, from the retaining studs **(2)**.

Next operation:
Cylinder head - Replace Gasket (B.10.A).

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HYDRAULIC - PNEUMATIC - ELECTRICAL - ELECTRONIC SYSTEMS - A

HYDRAULIC COMMAND SYSTEM - 14.A

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ELECTRICAL POWER SYSTEM - 30.A

Workmaster 45
Workmaster 55

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Alternator - General specification

WORKMASTER 45

Manufacturer	Mitsubishi
Model	A007T03877
Polarity	Negative Ground
Rotational Direction (viewed from pulley)	Clockwise
Drive Belt Tension	**10 - 15 mm** (**0.39 - 0.59 in**) deflection @ **89 - 111 N** (**20 - 25 lb**) of force
Adjusting Voltage	**14.5 - 15.0 V**
Load Characteristics	
Terminal voltage	**13.5 V**
Current	**40 A**
Rpm	**2500 RPM**
Brush Length	
Wear Limit (min. length)	**5 mm** (**0.2 in**)
Original	**18.5 mm** (**0.728 in**)
Brush Contact Rings	
Wear Limit (min. diameter)	**22.1 mm** (**0.87 in**)
Original Diameter	**22.7 mm** (**0.894 in**)
Bearing	
Front	ECSC8
Rear	6303DDG
Stator Coil Resistance	less than **1.0 Ω**
Rotor Coil Resistance	**2.8 Ω**

WORKMASTER 55

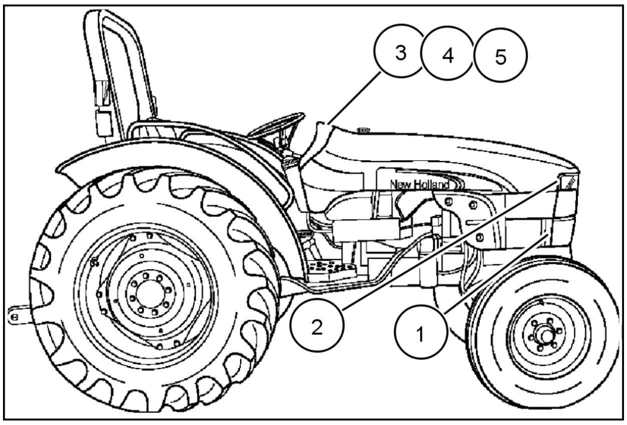
Type Name	A007TA1777
Rating	Continuous
Battery Voltage	**12 V**
Nominal Output	**12 V**, **55 A**
Mass	**3.7 kg**
Speed in Use	**1,000 - 18,000 RPM**
Number of Magnetic Poles	12
Temperature Rise - Hot condition	At **5,000 RPM** with MAX. Output after **40 min**
Temperature Rise - Thermal Endurance	Abnormal points not to be pointed out during running at any speed and with MAX. output current
Over speed at MAX. Output	**22,000 RPM**, **0.5 min**
Ground Polarity	Negative ground
Regulator System	IC Regulator built in
Initial cut in Speed	**12 V**, **50 Ω** **1,400 RPM** MAX
Regulator Performance - Set Voltage (**20 °C**)	**14.7 V ± 0.3 V**
When key is OFF, there is not around current that through outside unite on L Terminal	
(Remarks)	
1. Ambient temperature not to exceed **80 °C** during continuous running of Alternator. **90 °C** to be allowable for short interval running as not exceeding **10 min**	
2. Rotor Unbalance	**10 g** cm MAX
3. Inertia of Rotor	**10.2 Kg/cm^2**
4. Rotation of Pulley	Clockwise (View pulley)
5. Inspection Specification	Separately Agreed
6. Mounting end of bracket rear is acceptable not to be machined	
Initial Tension of Belt	Type A **470 N** MAX
Tolerance unless otherwise specified	Dimension : ± 1 Angle : ± **1 °**

ELECTRICAL POWER SYSTEM - Component localisation Electrical component location and Function

The electrical system is a **12 V** negative (-) ground system consisting of three wiring harnesses.

- Harness head lamp
- Harness Main
- Harness fender

1. Battery **(1)**- located under the hood, in front of the radiator.
2. Headlights **(2)** - located on the front grill; illuminate the front of the tractor.
3. Fuse Block **(3)** - located right side of engine compartment; controls current flow for individual circuits.
4. Relay Panel **(4)** - located under the instrument panel.
5. Ignition Switch **(5)** - located on the right side of the operator's console; controls current flow to the electrical system.



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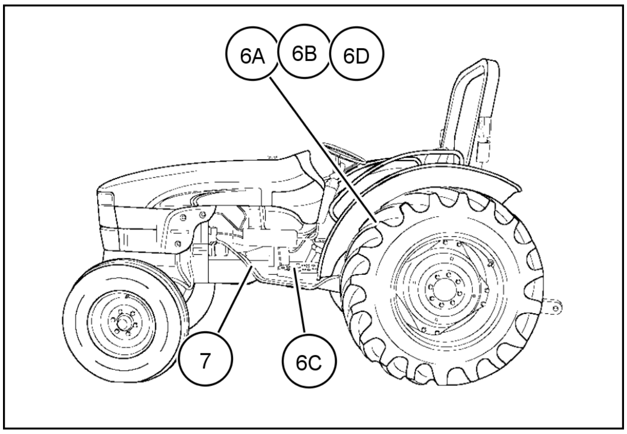
6. Safety Start Switches - control starting and safe operation circuits.
   Locations:
   - Range Gear **(6A)** - located on upper left side of transmission case.
   - PTO **(6B)** - located on the front side of the PTO quadrant.
   - Clutch **(6C)** - located underneath the left platform.
   - Seat **(6D)** - located on the bottom of the seat pan.
7. Fusible Link **(7)** - located on the left side of the engine compartment on starter wiring harness; controls current flow for the entire tractor.



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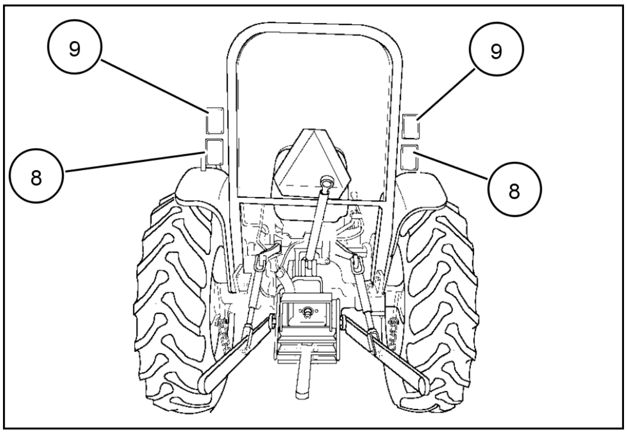
8. Taillights **(8)** - located on both sides of the roll bar illuminate the rear of the tractor.
9. Hazard Flashing Lights **(9)** - located on both sides of the roll bar; these amber-colored lights provide warning during transportation and emergency.



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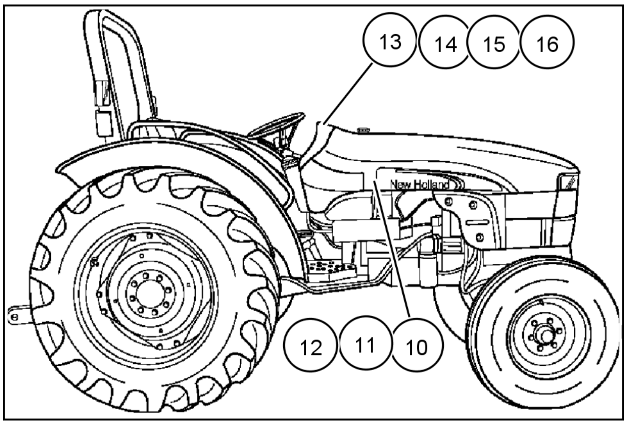
10. Turn Signal/Flasher Control Module **(10)** - located on the right side of the engine compartment.
11. Park Brake Alarm **(11)** - is located at the right side of the engine compartment. The alarm will sound for approximately eight seconds, warning the operator when an unsafe condition occurs.
12. Safety Module **(12)** - located at the right side of the engine compartment. This modules controls the safe operation circuits.
13. Instrument Panel **(13)** - located in the center of the dash; monitors tractor functions.
14. Light Switch **(14)** - located on the right side of the dash; controls current to front and rear lights.
15. Hazard Switch **(15)** - On left side of instrument panel; controls current flow to hazard flasher lights.
16. Turn Signal Switch **(16)** - located on the left side of the instrument panel; controls current flowing to the hazard flasher lights.



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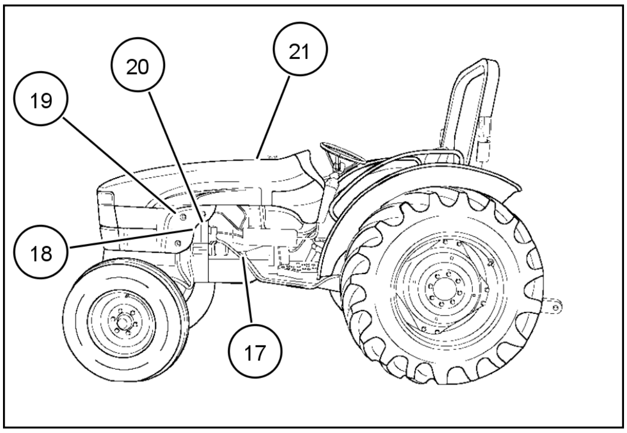
17. Starter **(17)** - located to the left side of the engine; rotates the engine for starting.
18. Alternator **(18)** - provides current flow to the battery; left side of engine.
19. Engine Oil Pressure Sending Unit **(19)** - located on the front of the cylinder head; provides warning of low engine oil pressure.
20. Engine Coolant Temperature Sending Unit **(20)** - located at the left front side of the engine inside the thermostat housing; warns when engine operating temperature reaches a high level.
21. Fuel Level Sending Unit **(21)**- located inside the fuel tank; sends a signal indicating fuel level to the instrument panel.



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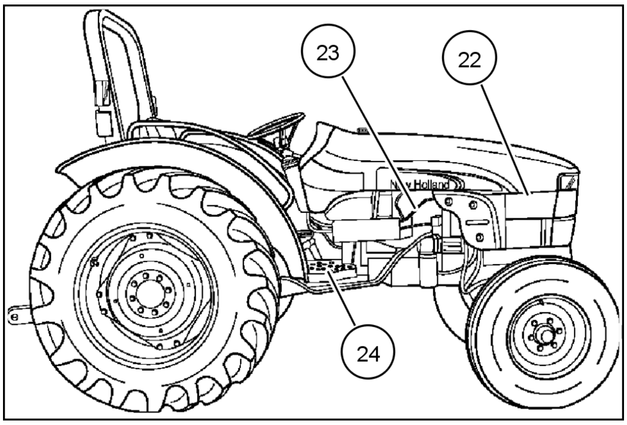
22. Air Restriction Switch **(22)** - located on the right side of the engine, in the air intake manifold, switch indicated a restriction in the air filter and allows the indicator light in the instrument panel to illuminate, when the air filter is restricted.
23. Fuel Shutoff Solenoid **(23)** - located on the right side of the engine; shuts off fuel flow to the injection pump to stop the engine.
24. Park Brake Switch **(24)** - located under the right platform; actuates with the parking brake mechanism; warns the operator that the park brake is engaged.



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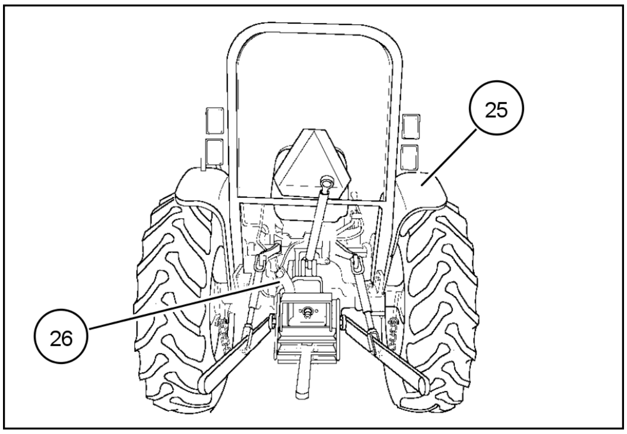
25. Optional Rear Work Light **(25)** (**50 W** Halogen) - located on the right side of the roll bar; power leads for the light are provided by the right fender wiring harness.
26. 7 Pin Connector **(26)** - located on the left rear axle housing of the tractor; provides current and light connection for towed implements.



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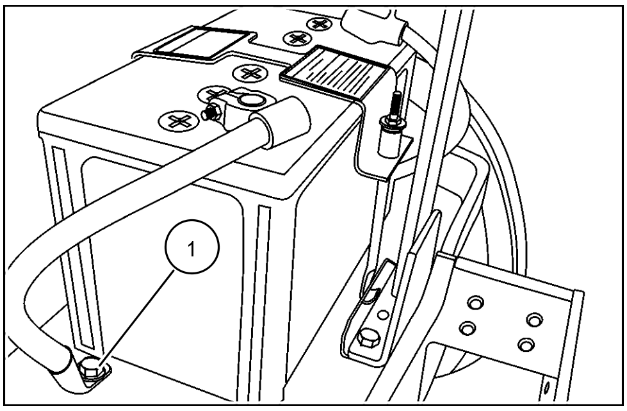
GROUNDS

1. Front of tractor frame, behind the battery.



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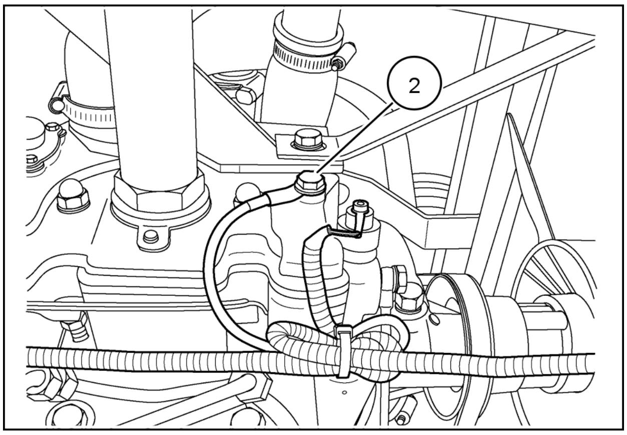
2. Front of engine.



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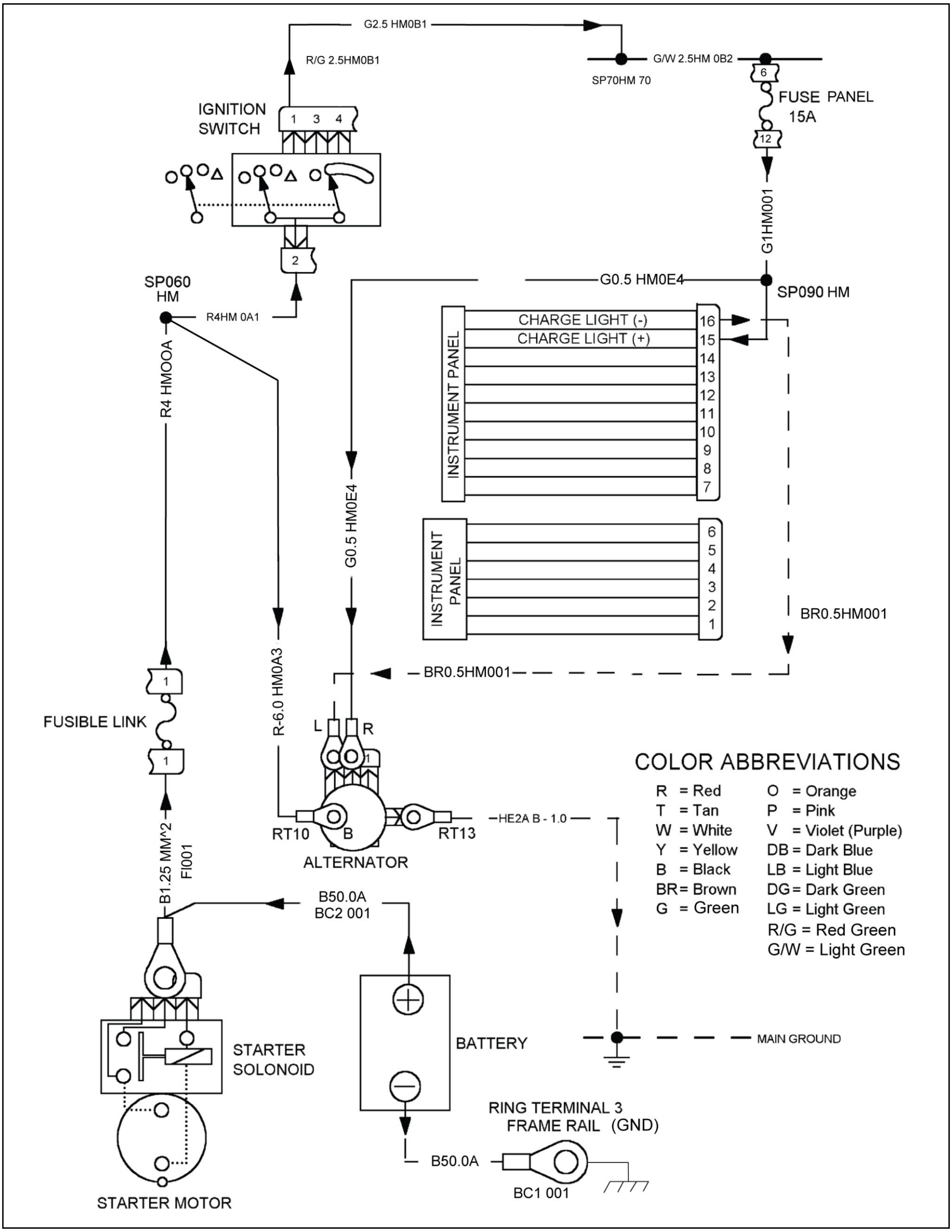
ELECTRICAL POWER SYSTEM - Wiring schema Charging circuit



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1. Current starts at the battery, and flows through the positive (+) battery cable to the engine starter motor.
2. From the starter motor, current flows through the fusible link to the positive (+) terminal of the battery and #2 terminal of the ignition switch.
3. When the ignition switch is placed in the "RUN" position current is transferred across the following ignition switch terminals:
   - #2 to #4 terminals

Terminal #1 of Ignition Switch

1. Current flows from the #1 terminal of the ignition switch to the fuse panel bussbar, from the bussbar current travels through the fuse panel, **15 A** fuse.

Fuse Functions

1. The fuse panel, **15 A** fuse, sends current to the #17 terminal of the instrument panel and to the "R" terminal of the alternator.

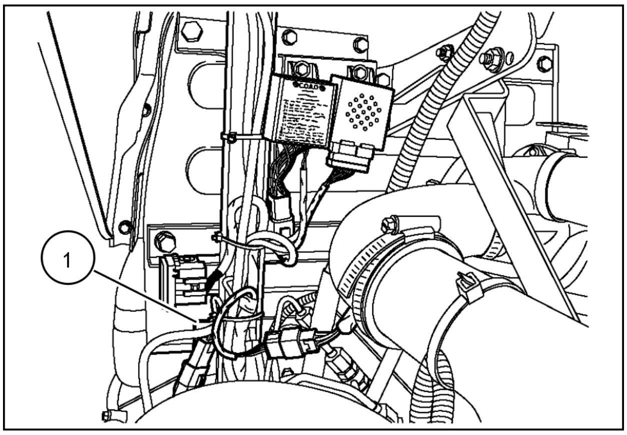
Alternator/Indicator Light

1. If the tractor engine is not running or the alternator is not producing a sufficient amount of charge, (with key switch in the "RUN" position) the charge light will illuminate.
   - The current for the indicator light is provided by terminal #17 of the instrument panel.
   - The ground source for the indicator light is provided by terminal #18 of the instrument panel, which is connected to terminal "L" of the alternator. The ground source for terminal "L" of the alternator is provided by the alternator field coil.
   - When the ground circuit is complete to terminal #18 and current is provided to terminal #15, the charge light will illuminate.
2. When the tractor engine is running with the alternator rotating and the ignition switch in the "RUN" position, the alternator produces an increased regulated voltage to the battery.
   - When the alternator is producing current, the ground circuit, through the "L" terminal, for the charge indicator light is disrupted, causing the indicator light to not illuminate.
   - The "R" regulator terminal controls the voltage output from the alternator. If current is not present at the "R" terminal the alternator will not produce current.
   - The "B" terminal of the alternator is the output connection between the alternator and then battery.

Fuse and relay box - Static description Diodes

A diode, **(1)**, is an electrical device through which current passes in one direction only. The diode is a plug-in style and are rated at **3 A** , **12 V**.

The diode, **(1)**, is located underneath the fuse access panel, below the instrument panel.



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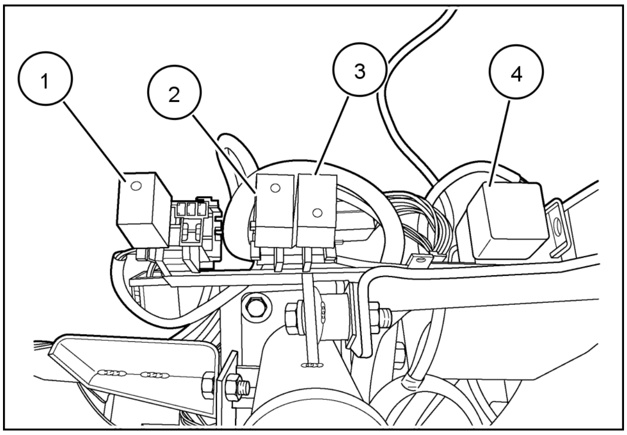
Fuse and relay box - Static description Relays

Relays monitor the current in a circuit. If current is present, the relay activates a single pole, double throw (SPDT) switch, causing it to flip over to its other position. The relays are located in the relay-diode panel found underneath the right and left rear side panels.

1. Hazard flasher cutoff relay, **(1)**.
2. PTO safety start relay, **(2)**.
3. Fuel shutoff relay, **(3)**.
4. Neutral start relay, **(4)**.

Relays **(1)**, **(2)**, and **(3)** are interchangeable.



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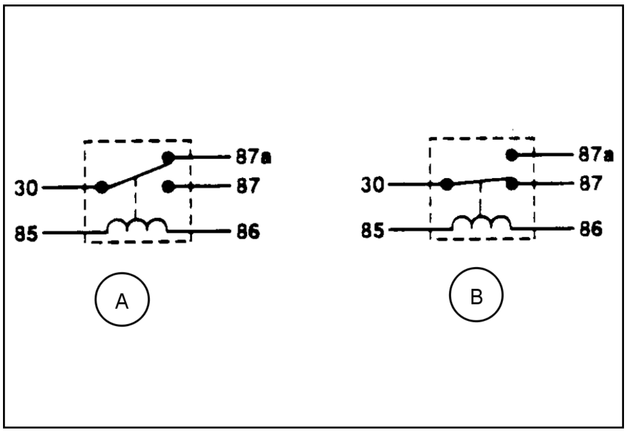
A relay consists of two parts which work together: a coil and an SPDT switch.

Terminals 85 and 86 are connected to a coil. Applying 12 volts to these terminals energizes the coil, turning it into an electromagnet.

Terminals 30, 87 and 87A are actually part of a single pole, double throw switch, with terminal 30 being the common lead.

The SPDT switch is spring loaded so terminals 30 and 87A are closed when the coil is not energized. When the coil is energized, the switch is thrown, and terminals 30 and 87 are connected.



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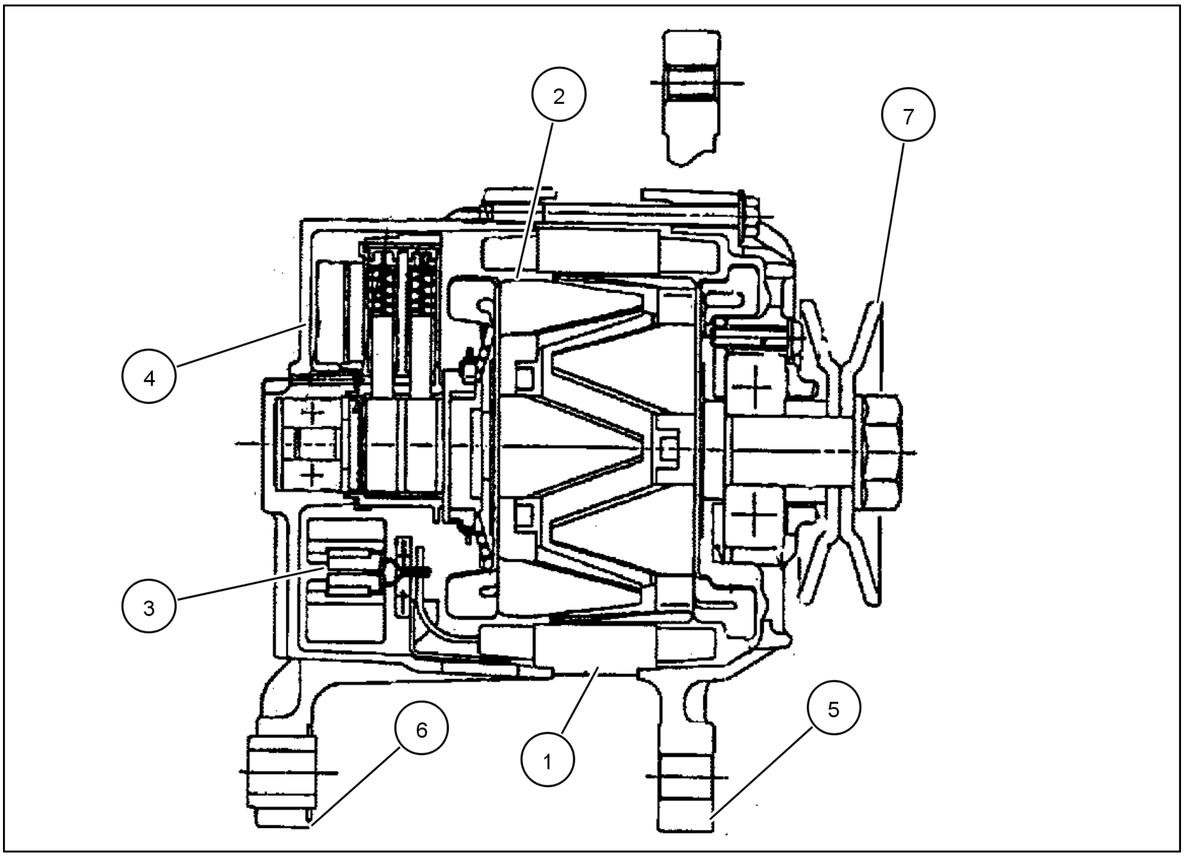
A - RELAY (NOT ENERGIZED)
B - RELAY (ENERGIZED)

Alternator - Static description



20098351 1

Alternator

Description of Operation

Tractors are equipped with a **40 A** output alternator. The alternator is equipped with an integrated circuit (IC) regulator, meaning voltage is regulated internally and electronically within the alternator.

The principle components of the alternator are the stator, **(1)** the rotor **(2)** the rectifier assembly, **(3)** and the IC regulator **(4)**.

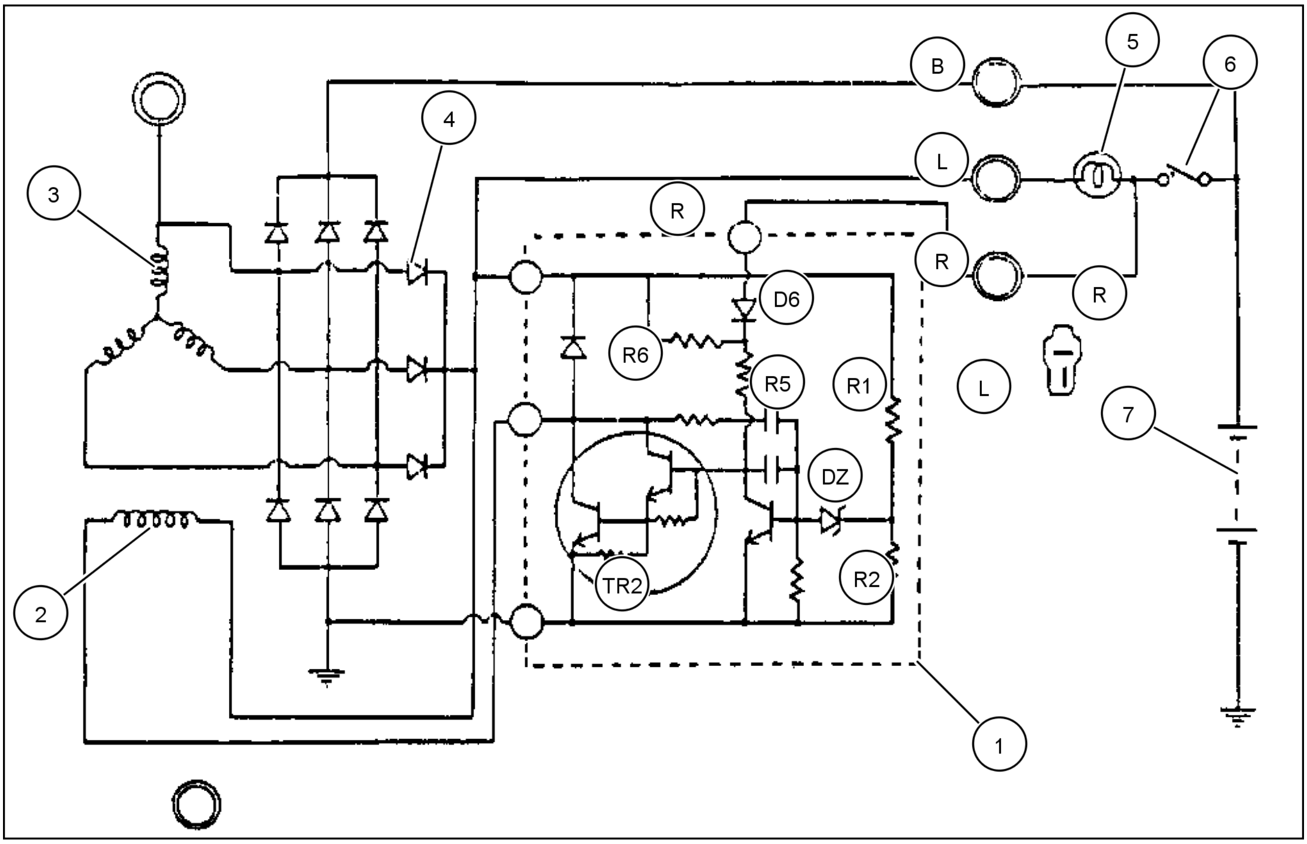
The rectifier assembly, **(3)**, consist of two heat sinks, one positive (+) and one negative (-) and a diode trio.

The diode trio is used as a field supply diode and is connected to terminal 'L' on the alternator.

The IC regulator **(4)** is a solid state unit and can only be serviced as an assembly.

The internal components of the alternator are housed in a two-piece frame, which is divided into a drive end (front) frame, **(5)** and a rear frame **(6)** The frame contains open slots to allow for cooling of the alternator.

The alternator is rotated in the frame by using a belt-driven pulley, **(7)** which is powered off of the engine crankshaft pulley by a belt.



20098352 2

Charging Circuit

The charging circuit and internal connections are shown. The charging system consists of an IC voltage regulator, **(1)**, (enclosed with dotted lines) ,a battery **(7)** and connecting wires. Because of the use of IC, the voltage regulator is very compact and is built into the alternator.

The IC voltage regulator, **(1)** permits the field current to flow directly from the diode trio **(4)** to the field coil, **(2)**, without passing through the external circuit. Consequently, there are no voltage drops caused by the key switch or the external wiring as with conventional vibrating-contact regulators mounted separately from the alternator. To aid in initial voltage buildup when the engine is started the field current is supplied through the indicator lamp **(5)** from the battery **(7)**.

Since the frequency pulse output of 1/10 the alternator speed develops on the 'P' terminal, this terminal is used for speed detection.

Principle of IC Regulator

The basic function of the IC voltage regulator is to make the terminal voltage constant by detecting the generated voltage and increasing/decreasing the field current.

As indicated, the regulator consists of two basic sections: a voltage control device and an output device to handle the field current. The voltage control device includes the voltage divider network, R1 and R2, a zener diode, DZ, for voltage reference, and a single amplifying transistor, Tr1. The output device is a darlington-type amplifier which is called power transistor, Tr2. The power transistor, Tr2, is placed in series with the alternator field coil and ground.

The signal amplifying transistor, Tr1, senses the generated voltage and turns the power transistor, Tr2, on and off many times per second most of the time the engine is in operation.

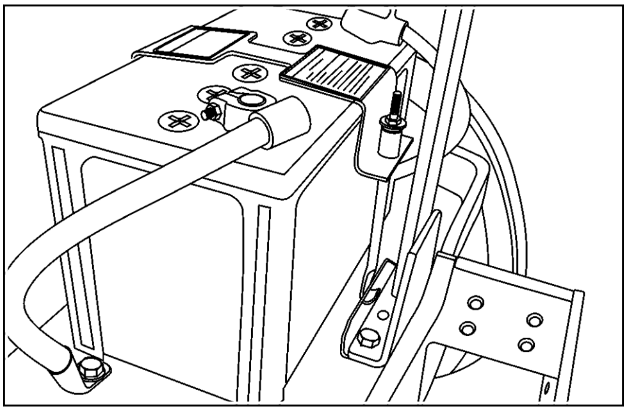
The basic operating principles are explained as follows, see Figure **2**:

1. When the key switch, **(6)**, is closed current from the battery **(7)** flows through the indicator lamp, **(5)** and resistor R6, which are in parallel to the field coil **(2)**. From here it continues to flow on through the field coil **(2)**, to the ground completing the circuit back to the battery **(7)**.
2. When the alternator begins to rotate, AC voltages are generated by the stator coil **(3)**. The diodes in the rectifier assembly change the stator AC voltages to DC voltage which appears between ground and the 'B' terminal.
3. The stator also supplies DC field current through the diode trio **(4)**, the field coil **(2)**, the power transistor, Tr2, and then through the diodes in the rectifier assembly back to the stator.
4. When the generated voltage is low, no current flows in the zener diode, DZ, since the voltage at point 'A' is lower than the zener voltage.
5. As the speed and voltage increase, the voltage at point 'A' also increases until it reaches the limiting value set at the factory. As the zener diode, DZ, breaks down, current flows through R1, DZ, and the base-emitter circuit of Tr1 to ground. This renders Tr1 conductive, so that much of the current flows through the collector emitter circuit of Tr1. This reduces the base current of Tr2 thereby reducing the field current. This means that Tr1 turns on and Tr2 turns off.
6. When the generated voltage decreases, the zener diode, DZ, again turns off and Tr1 also turns off. This cycle repeats many times per second, and the alternator output voltage is, therefore, regulated within a narrow limit.

   In other words, the action is similar to the conventional vibrating-contact regulator, in that current to the field coil, **(2)**, is varied to limit the output voltage, but in place of the voltage coil and spring system there is a voltage divider network, R1and R2, and a zener diode, DZ

Battery - Static description

The WORKMASTER 45 and WORKMASTER 55 tractors are equipped with a BCI group 47, **12 V** battery with a minimum cold cranking ability of **600 A** at **-18 °C** (**0 °F**)The battery is located under the hood in front of the radiator.


20099930 1

The battery connections must be tight and free of corrosion. If necessary, wash the battery's outside surface and terminals with a solution of baking soda and water, making sure the solution does not get inside the battery. After cleaning, wash the battery with clean water, then apply a small amount of petroleum jelly to the terminals to prevent corrosion.

A good battery charge must be maintained in freezing temperatures. If the battery is allowed to become discharged or run down, the electrolyte will become weak and possibly freeze. This can result in damage to the case. If water must be added, use distilled water. Add the water just before using the tractor. This ensures that the water will mix with the electrolyte during the charging process, preventing the water from freezing.

Check the specific gravity of the electrolyte to determine battery charge.

Wiring harness - Electrical schematic frame 01 - sheet 01

ELECTRICAL SCHEMATIC DIAGRAM
NEW HOLLAND WORKMASTER 45 AND 55
TRACTOR

CIRCUIT DESCRIPTION	PAGE
CHARGING SYSTEM & STARTING SYSTEM	2
GROUNDS	5
HAZARD MODULE/SWITCH	6
INSTRUMENTS	9
MAIN & WARNING/POSITION LIGHTS	8
SAFETY SYSTEM	3,4
TRAILER SOCKET	10
MAIN & TURN SWITCHES	7

HARNESSES DERIVED FROM SCHEMATIC

SN	PART NUMBER	PART NAME	REV. NO.
1	87645931	HARNESS ASSEMBLY FENDER	A
2	84645932	HARNESS MAIN	B
3	82826742	HARNESS HEAD LAMP	A

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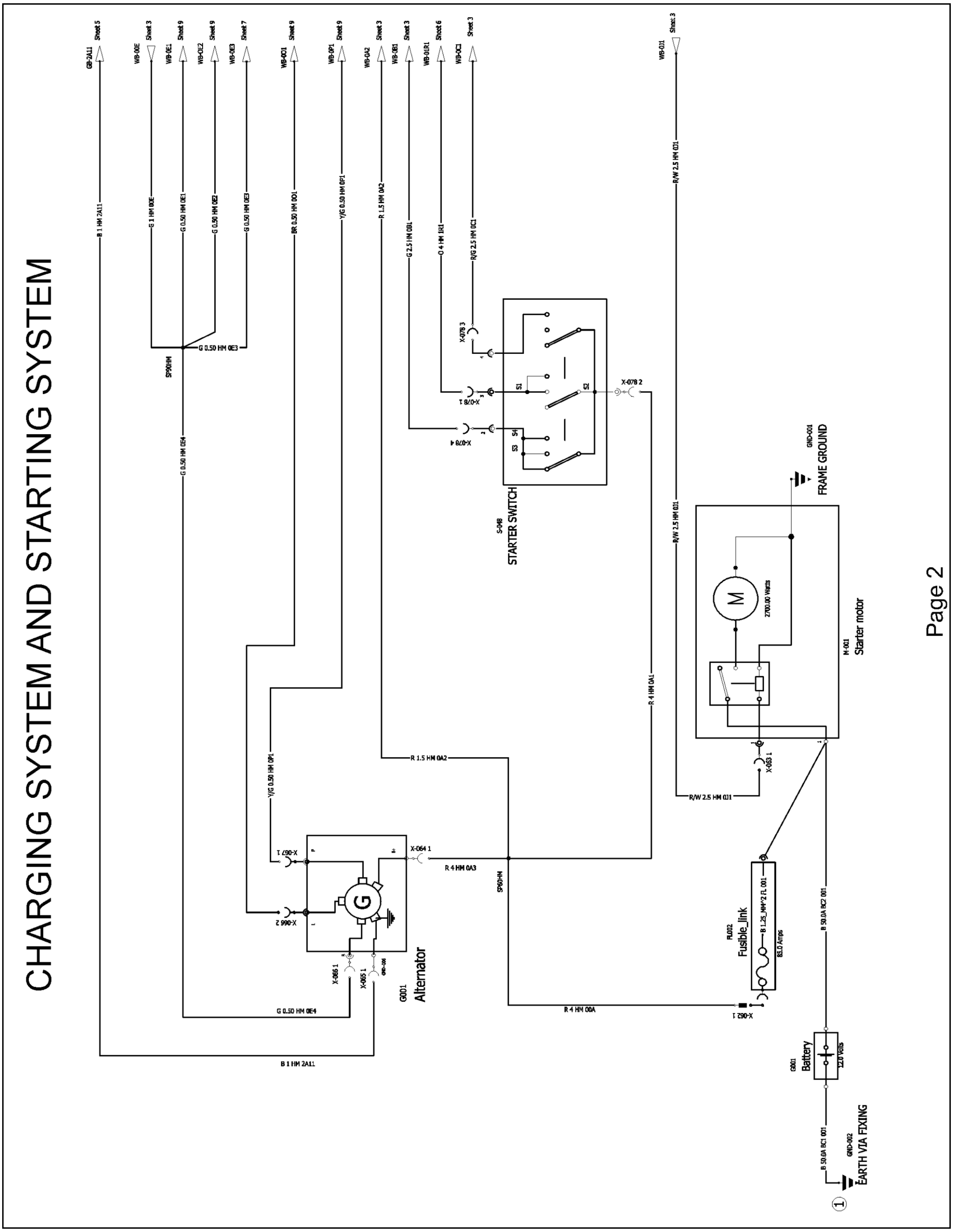
Wiring harness - Electrical schematic frame 02 - sheet 02



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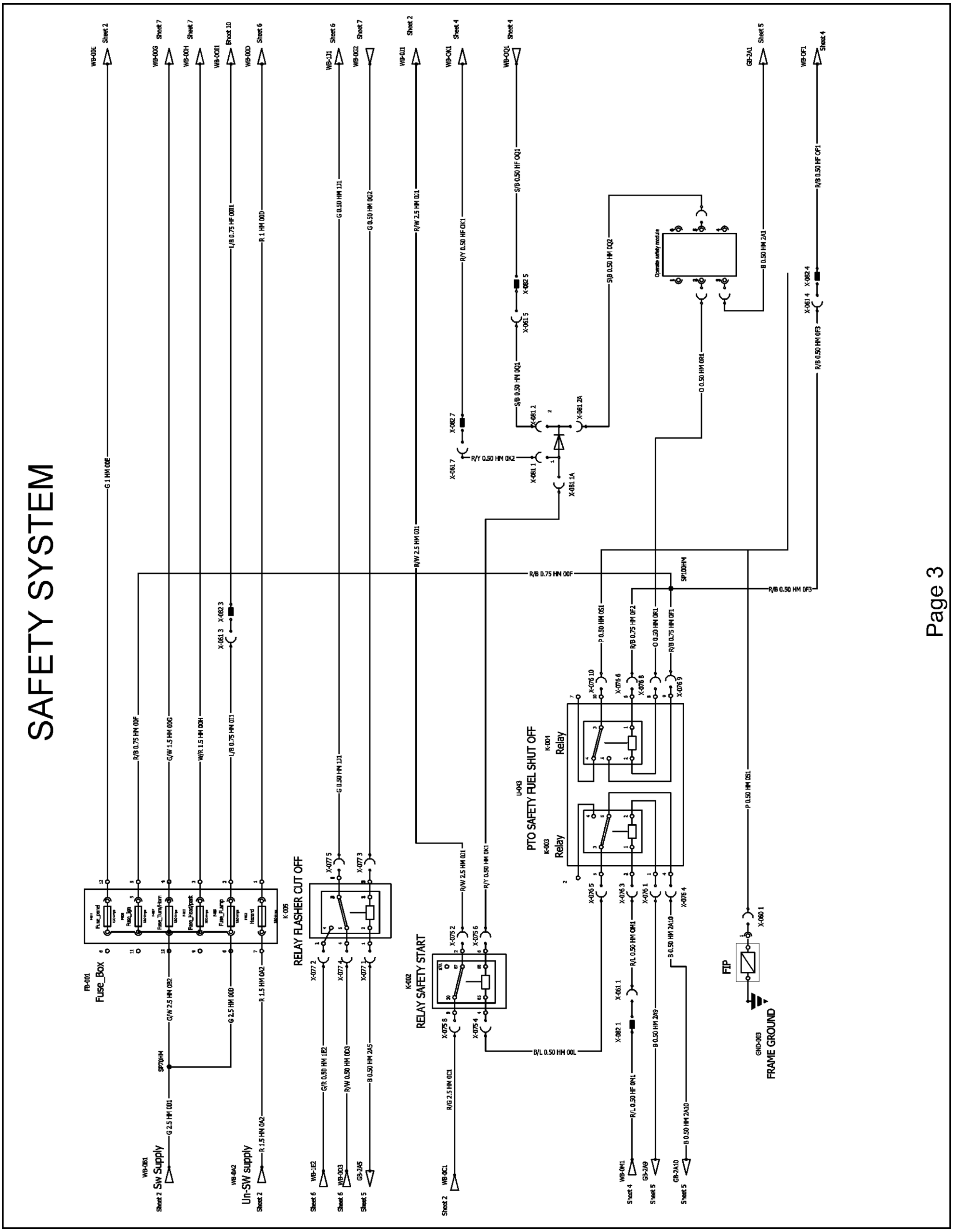
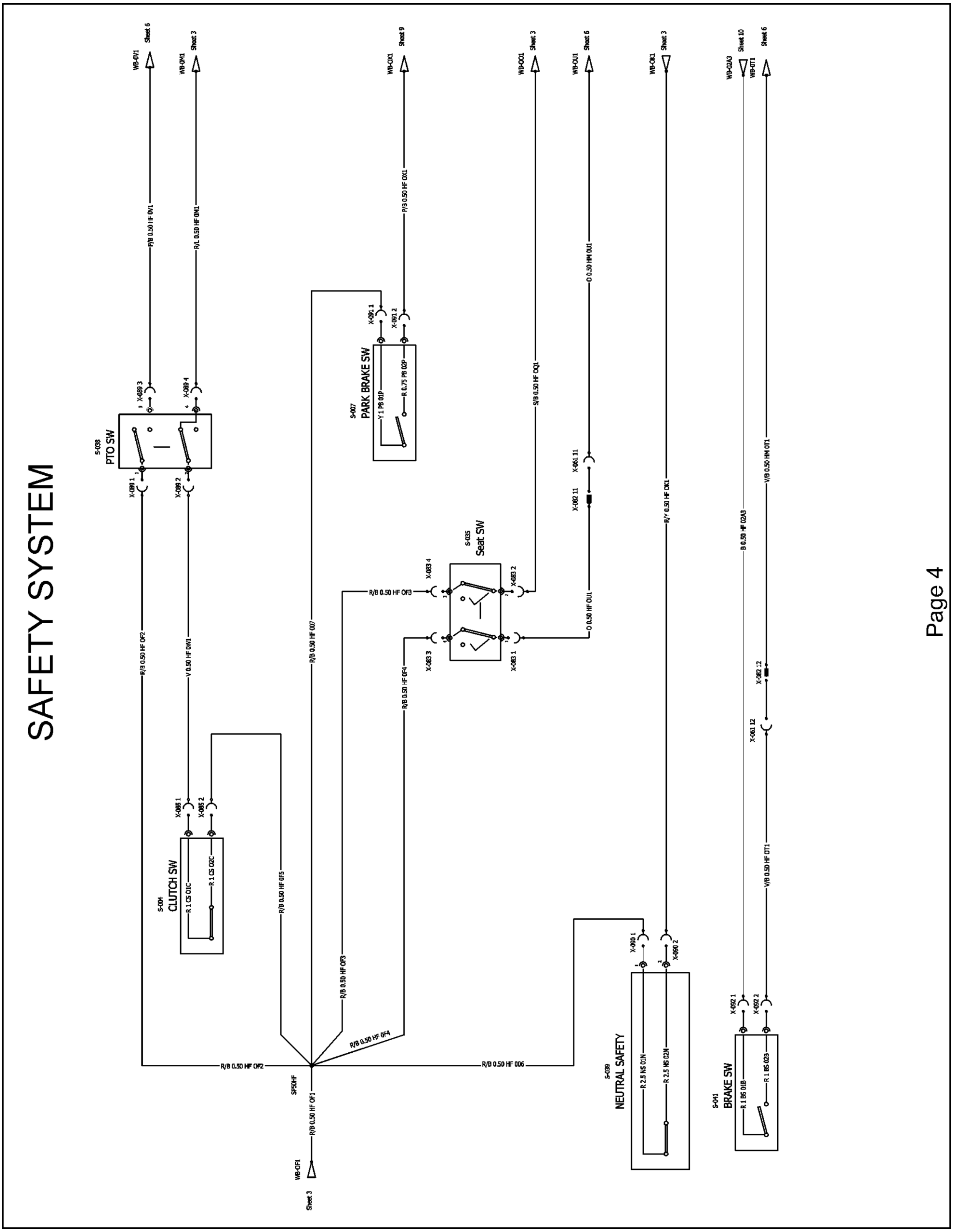
Wiring harness - Electrical schematic frame 03 - sheet 03



84206530_03 1

Wiring harness - Electrical schematic frame 04 - sheet 04



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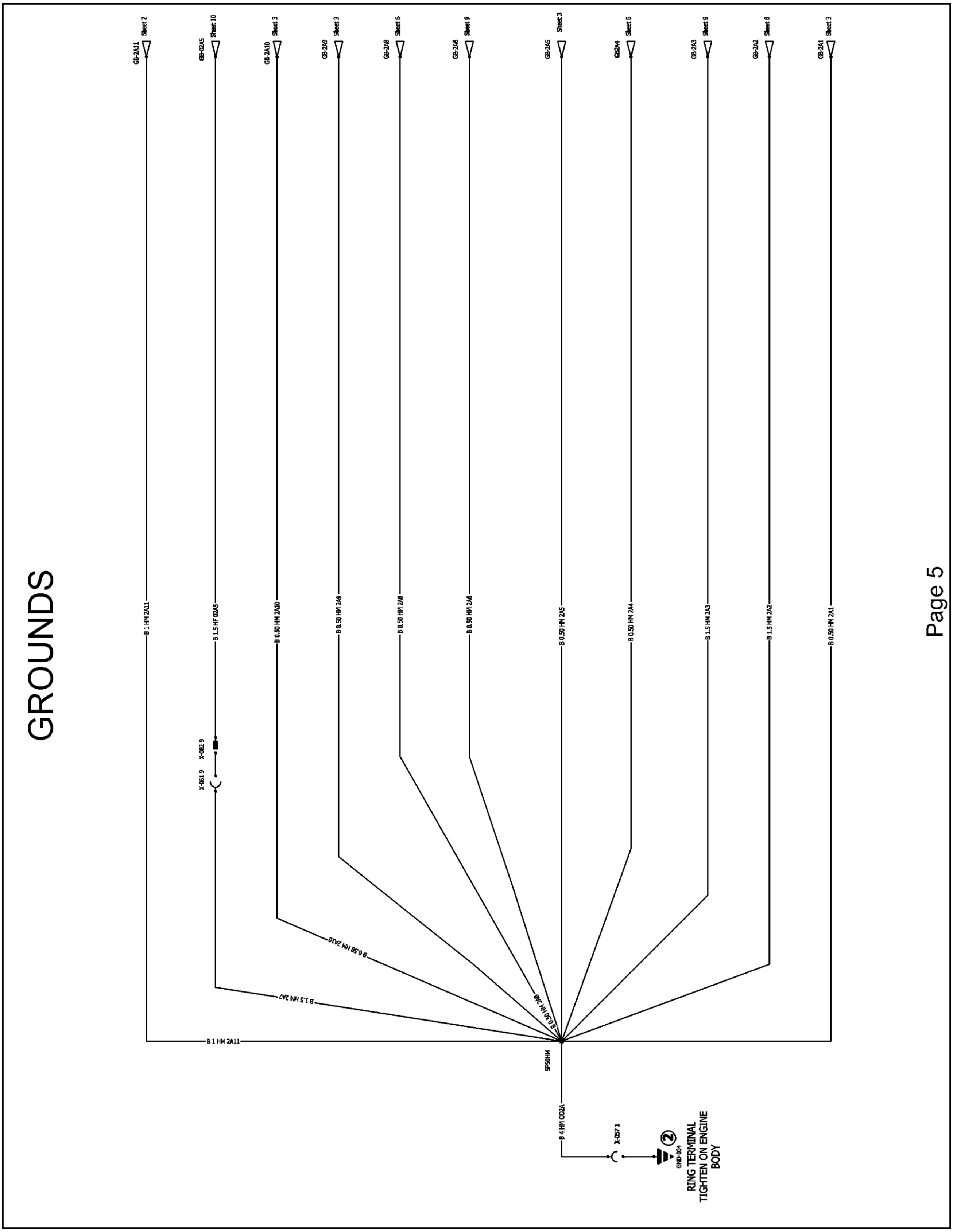
Wiring harness - Electrical schematic frame 05 - sheet 05



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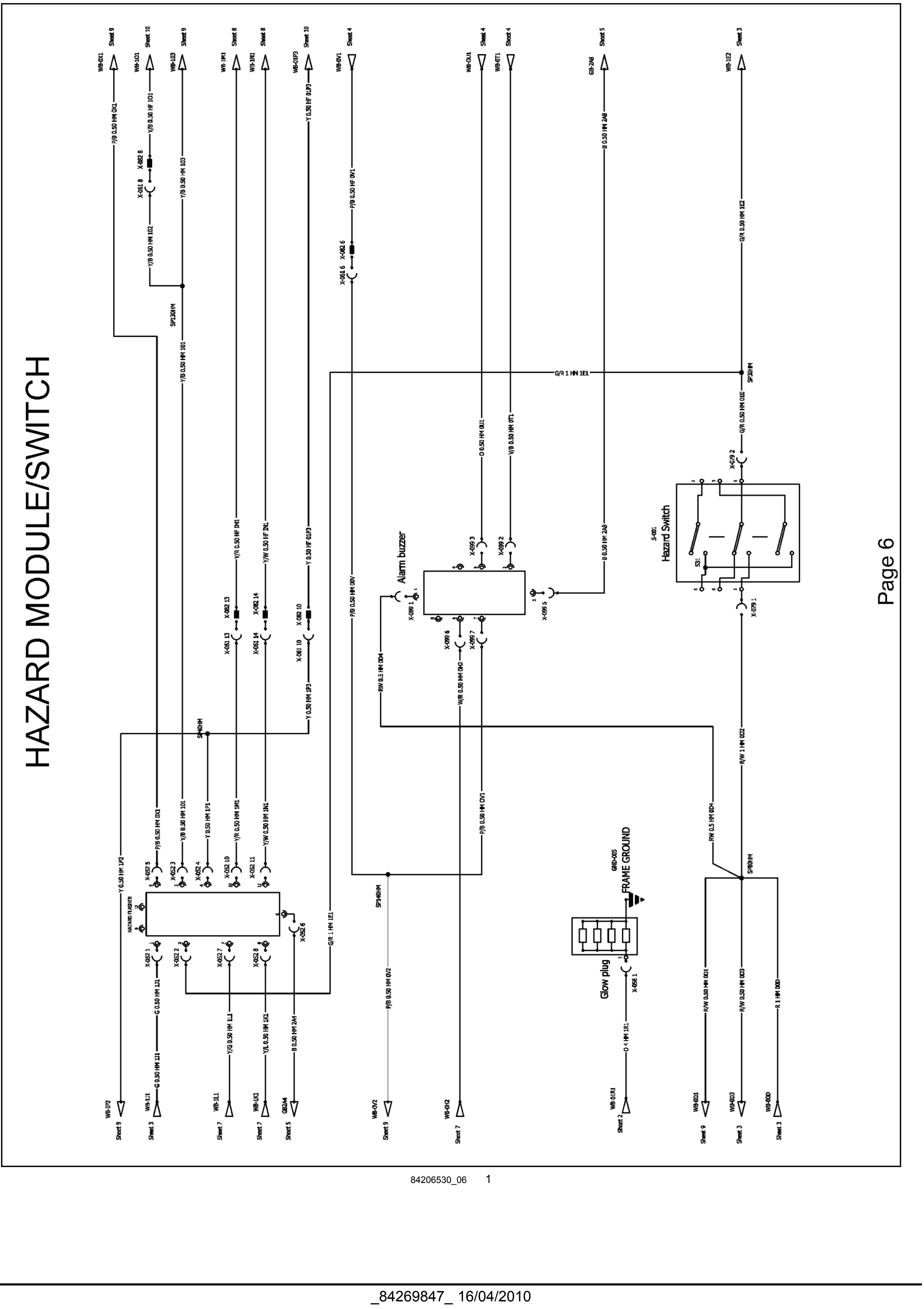
Wiring harness - Electrical schematic frame 06 - sheet 06



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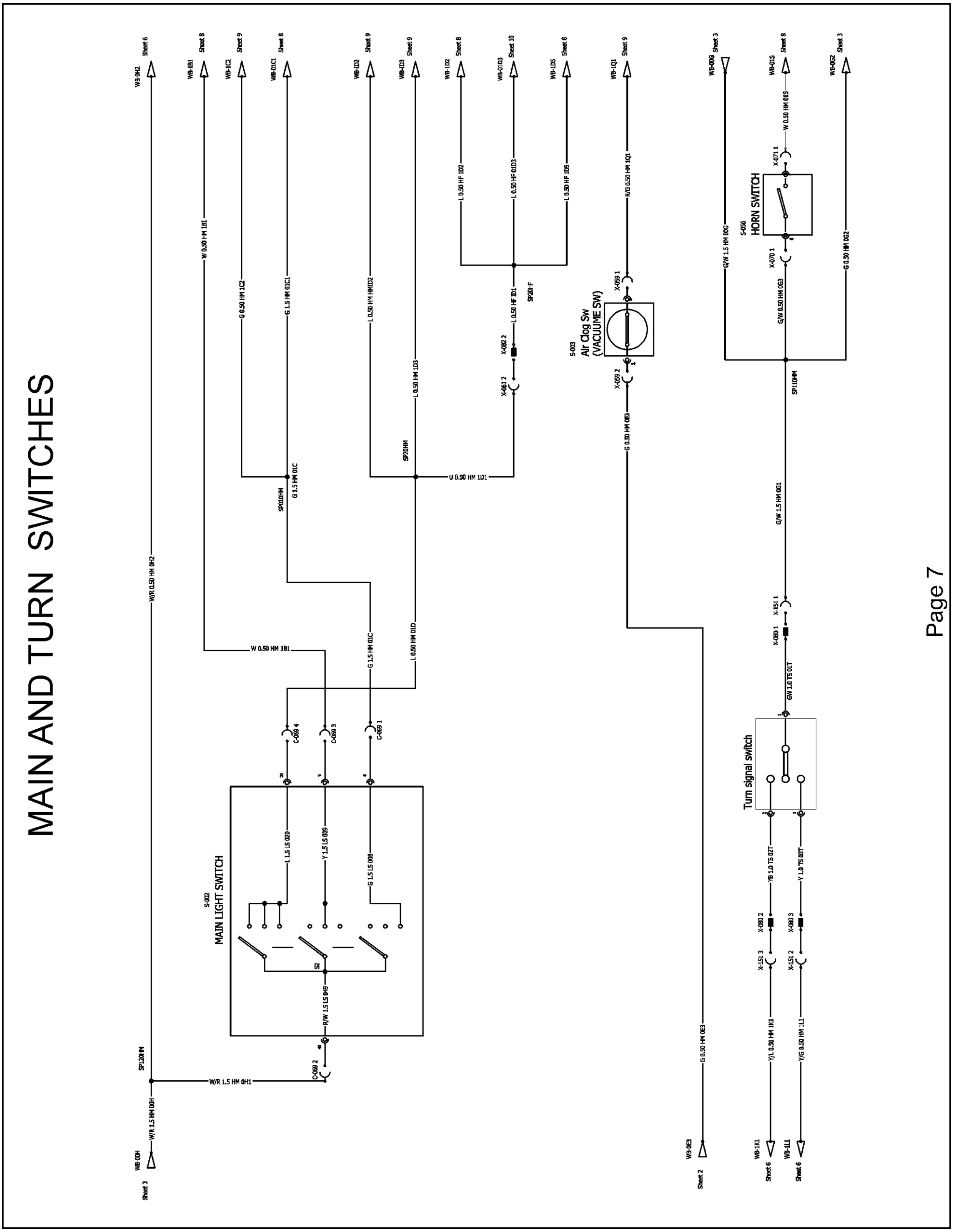
Wiring harness - Electrical schematic frame 07 - sheet 07



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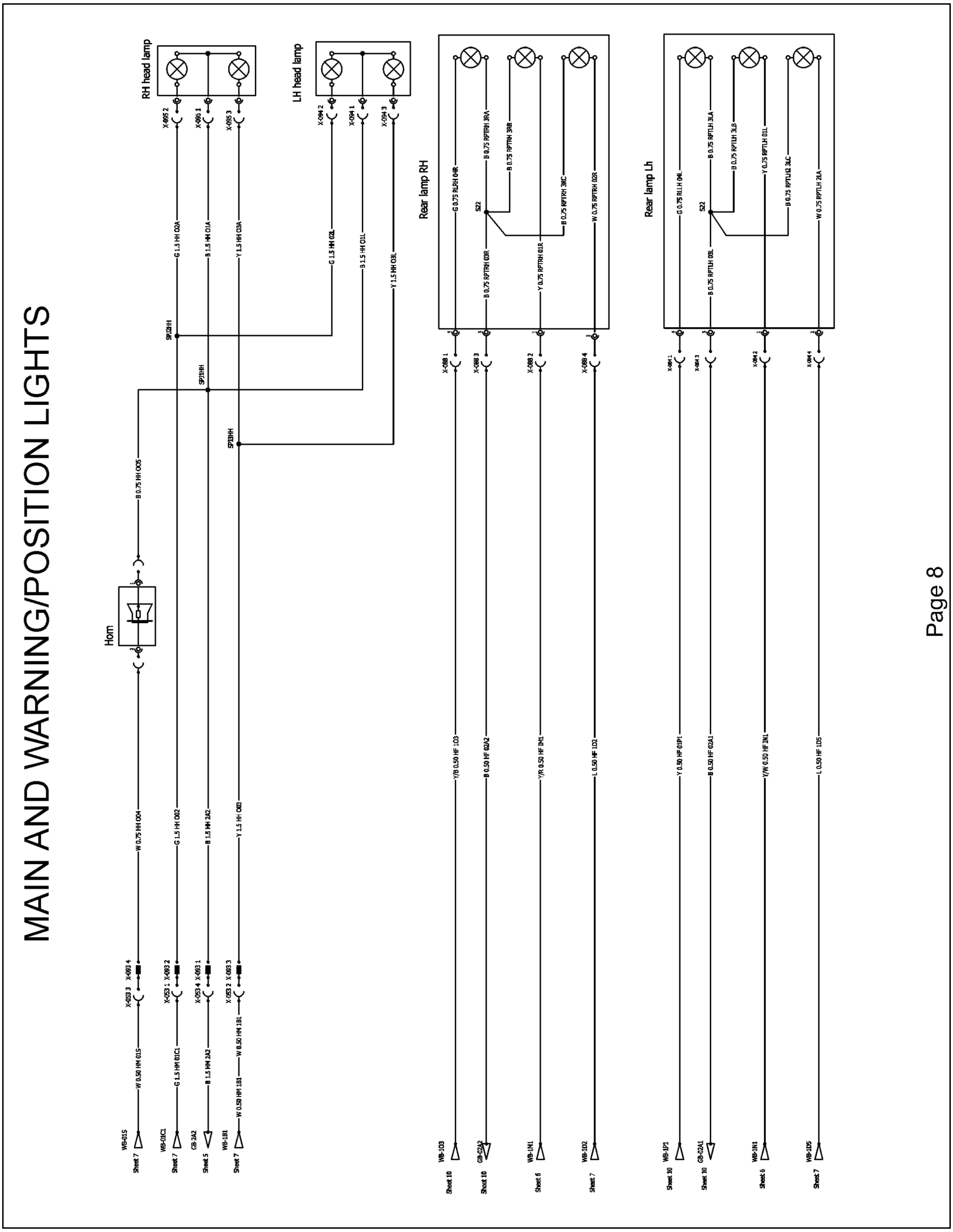
Wiring harness - Electrical schematic frame 08 - sheet 08



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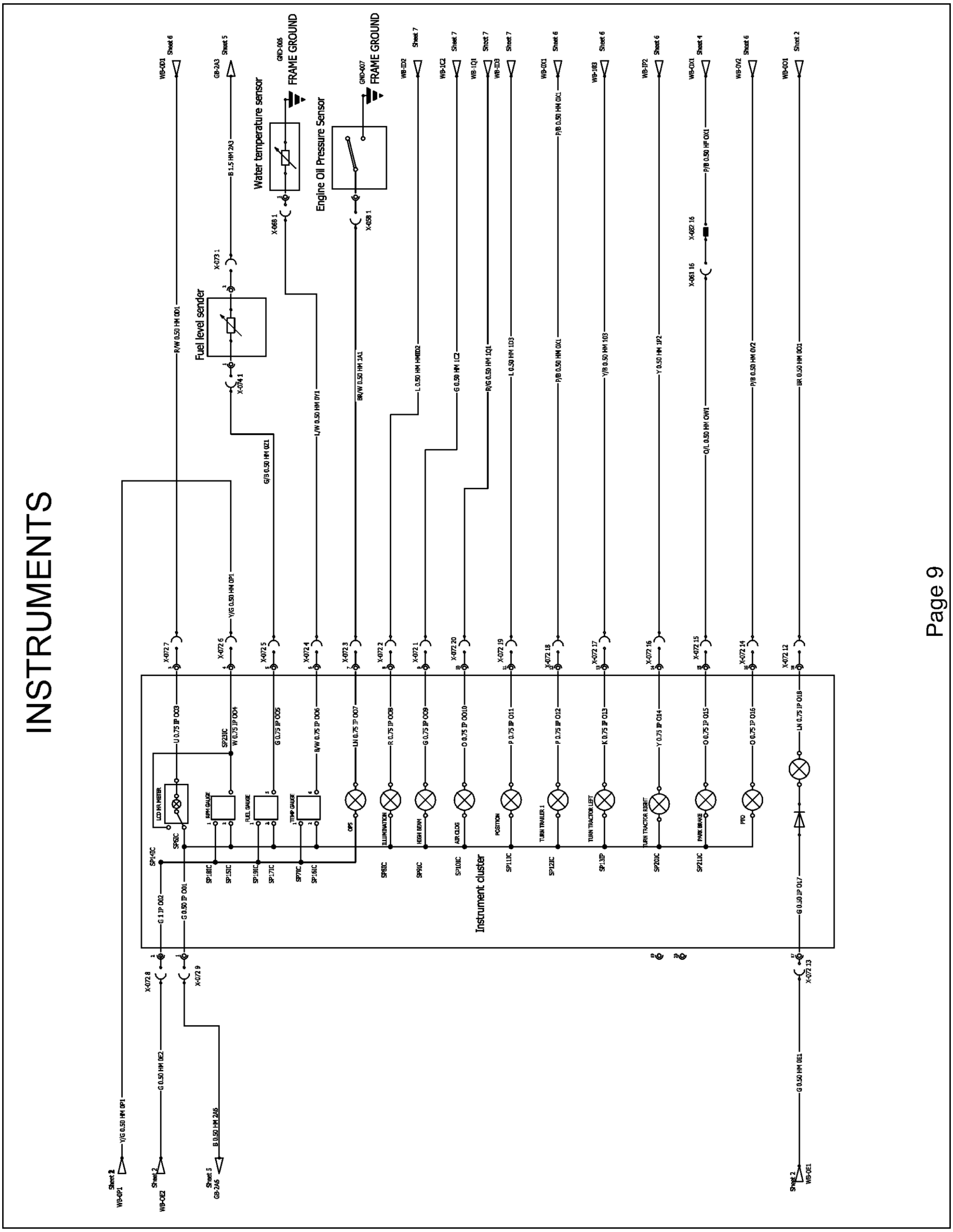
Wiring harness - Electrical schematic frame 09 - sheet 09



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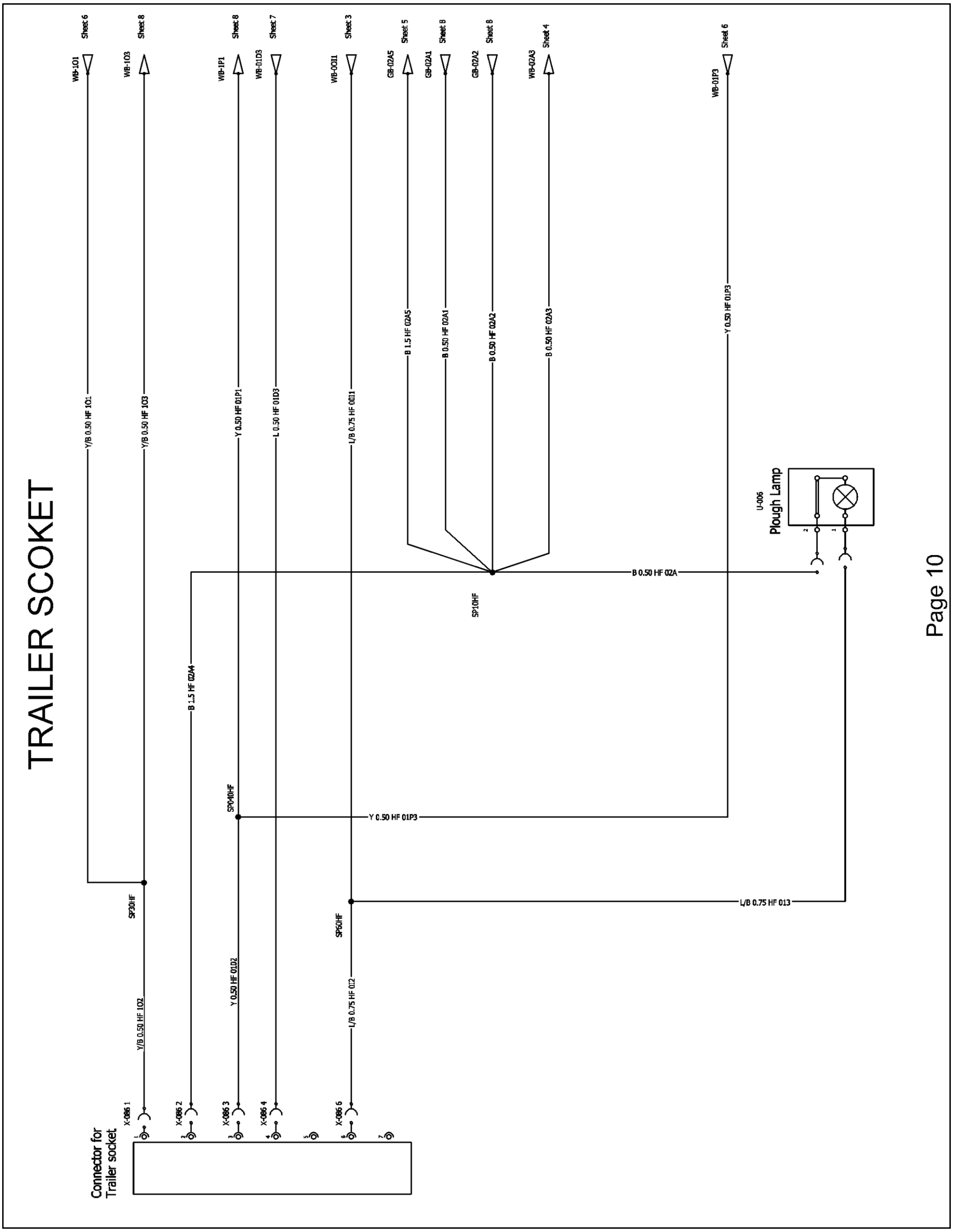
Wiring harness - Electrical schematic frame 10 - sheet 10



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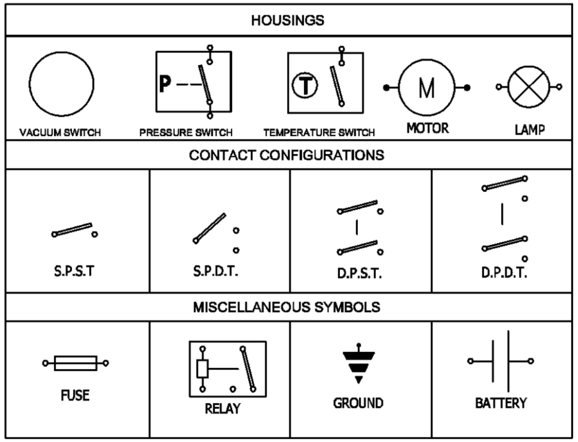
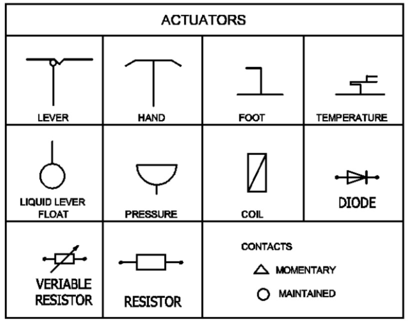
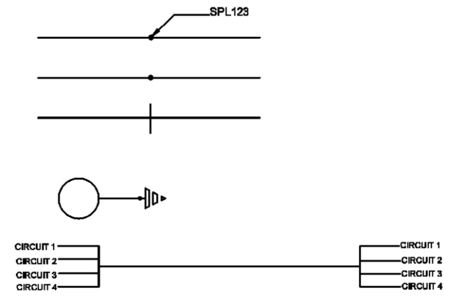
Wiring harness - Electrical schematic frame 11 - sheet 11







NOTES:

1. DIAGRAM SHOWN WITH VEHICLE PARKED AND POWER OFF
2. THE CONNECTOR GENDER ON THIS DIAGRAM IS INDENTIFIED BY THE GENDER OF THE CONNECTOR BODY AND NOT THE TERMINALS USED

COLOR ABBREVIATIONS

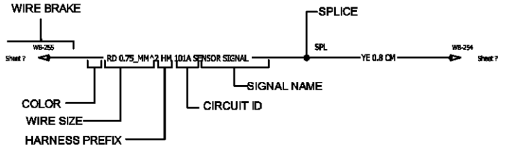
ABBREVIATION	COLOR	ABBREVIATION	COLOR
R	RED	O	ORANGE
G/W	GREEN/ WHITE	P	PINK
W	WHITE	V	VIOLET (PURPLE)
Y	YELLOW	L	BLUE
B	BLACK	SB	SKY BLUE
G	GREEN	R/G	RED/GREEN
G/R	GREEN /RED	R/L	RED/BLUE
Br	BROWN	R/B	RED/BLACK
R/B	RED/BLACK	R/Y	RED/YELLOW
L/B	BLUE/BLACK	W/R	WHITE/RED
R/W	RED/WHITE	R/B	RED/BLACK
P/B	PINK BLACK	V/B	VIOLET / BLACK
Y/B	YELLOW/ BLACK		

IN WIRE WITH TWO COLORS—— FIRST IS PRIMARY COLOR AND SECOND COLOR FOR STRIP ON WIRE

HARNESS PREFIX DEFINITION

PREFIX	DESCRIPTION	REMARKS
HF	HARNESS FENDER	
HH	HARNESS FENDER	
HM	HARNESS MAIN	
NS	NEUTRAL SWITCH HARNESS	COMPONENTS WITH FLYING LEADS
TS	TURN SIGNAL HARNESS	COMPONENTS WITH FLYING LEADS
BS	BRAKE SWITCH HARNESS	COMPONENTS WITH FLYING LEADS
PB	PARK BRAKE SWITCH HARNESS	COMPONENTS WITH FLYING LEADS
CS	CLUTCH SW HARNESS	COMPONENTS WITH FLYING LEADS
IP	INSTRUMENT CLUSTER HARNESS	COMPONENTS WITH FLYING LEADS
LS	LIGHT SWITCH HARNESS	COMPONENTS WITH FLYING LEADS
RLRH	REAR LIGHT RH HARNESS	COMPONENTS WITH FLYING LEADS
RLLH	REAR LIGHT LH HARNESS	COMPONENTS WITH FLYING LEADS

CIRCUIT DIAGRAM LEGENDS



Page 11

84206530_11 1

Wiring harness - Electrical schematic frame 12 - sheet 12

Splice Table

Splice Name	Frame Location	Harness Used On	Circuit
SP60HM	2	Harness Main	UNSW Supply
SP90HM	2	Harness Main	
SP70HM	3	Harness Main	SW Supply
SP100HM	3	Harness Main	Fuse Ign. Supply
SP50HF	4	Harness Fender	Fuse Ign. Supply
SP50HM	5	Harness Main	Ground On Supply
SP40HM	6	Harness Main	Turn Signal Right-hand
SP140HM	6	Harness Main	PTO Operation Signal
SP80HM	6	Harness Main	Hazard Signal I/P
SP30HM	6	Harness Main	Hazard Signal O/P
SP130HM	6	Harness Main	Signal Turn Left-hand
SP20HM	7	Harness Main	Position Light & ACC
SP10HM	7	Harness Main	Low Beam
SP20HF	7	Harness Fender	Position Light
SP10HH	8	Harness Head Lamp	Ground Head Lamp
SP20HH	8	Harness Head Lamp	Signal High Beam
SP30HH	8	Harness Head Lamp	Signal Low Beam
SP7IC	9	Harness Ins. Cluster	Temp. Gauge Lamp +VE
SP8IC	9	Harness Ins. Cluster	Illumination Lamp +VE
SP9IC	9	Harness Ins. Cluster	High Beam Lamp +VE
SP10IC	9	Harness Ins. Cluster	Air Clog Lamp +VE
SP11IC	9	Harness Ins. Cluster	Position Lamp +VE
SP12IC	9	Harness Ins. Cluster	Turn Trailer Lamp 1
SP13IC	9	Harness Ins. Cluster	Turn Trac. Left-hand Lamp
SP14IC	9	Harness Ins. Cluster	SW. Positive
SP15IC	9	Harness Ins. Cluster	RPM Gauge Lamp Gnd.
SP16IC	9	Harness Ins. Cluster	Temp. Gauge Lamp Gnd.
SP17IC	9	Harness Ins. Cluster	Fuel Gauge Lamp Gnd.
SP18IC	9	Harness Ins. Cluster	RPM Gauge Lamp +VE
SP19IC	9	Harness Ins. Cluster	Fuel Gauge Lamp +VE
SP20IC	9	Harness Ins. Cluster	Turn Right-hand Lamp Gnd.
SP21IC	9	Harness Ins. Cluster	Park Brake Lamp Gnd.
SP10HF	10	Harness Fender	Work Lamp +VE
SP30HF	10	Harness Fender	Turn Right-hand Trailer Socket
SP40HF	10	Harness Fender	Turn Left-hand Trailer Socket
SP60HF	10	Harness Fender	Gnd. Worklamp & Trailer Socket

Wiring harness - Electrical schematic frame 13 - sheet 13

Fuse Table

Fuse ID	Fuse Rating	Frame Location	Circuit Identification
F-007	15	3	Turn & Horn
F-008	15	3	Ignition
F-009	15	3	Plough/Work Lamp
F-010	20	3	Head/Parking Lamp
F-011	15	3	Cluster (Panel)
F-012	15	3	Hazard
FL-002	85	2	Fusible Link

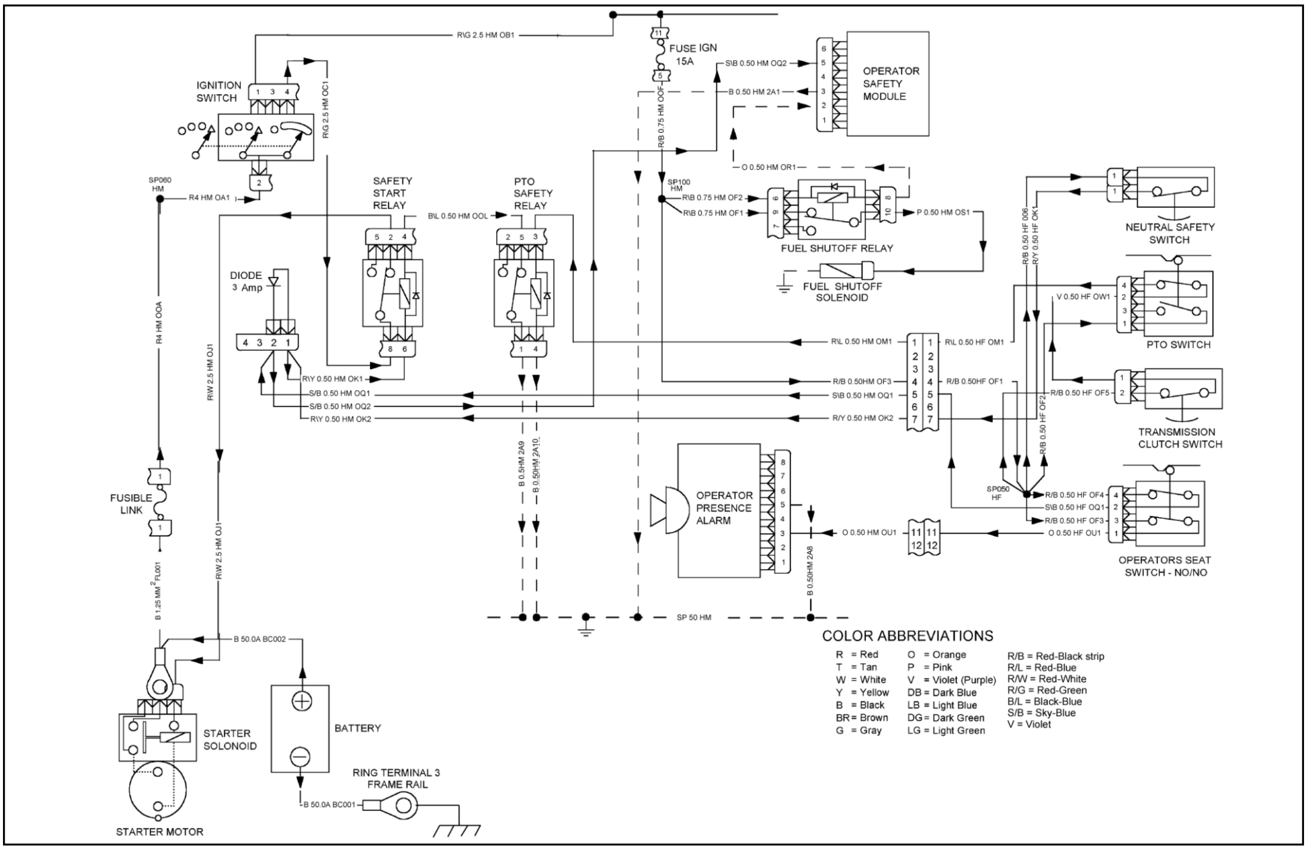
Ground Table

Ground #	Module	Frame Location	Function
GND-002	Battery	2	Battery Ground (Physical Gnd.1)
GND-001	Starter Motor	2	Frame Ground Starter Motor
GND-006	Alternator	2	Alternator Body Ground
GND-003	FIP	3	FIP Frame Gnd.
GND-004	Engine	5	Physical Ground 2
GND-006	Glow Plug	6	Glow Plug Frame Gnd.

Relay Table

Relay No.	Page Location	Function
K-002	3	Relay Safety Start
K-003	3	PTO Safety Fuel Shut Off
K-004	3	PTO Safety Fuel Shut Off
K-005	3	Relay Flasher Cut Off

Wiring harness - Wiring schema Safety start circuit - Operator present



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NOTE: *The starting circuit is shown with:*

- Operator in the seat
- Transmission clutch pedal depressed
- Transmission range lever in "NEUTRAL" position
- PTO clutch lever in the "OFF" position

1. Current starts at the battery, and flows through the positive (+) battery cable to the engine starter motor.
2. From the starter motor, current flows through the fusible link to the #2 terminal of the ignition switch.
3. When the ignition switch is placed in the "START" position current is transferred across the following ignition switch terminals:
    - #2 to #3 terminals
    - #2 to #4 terminals

Terminal #4 of Ignition Switch

1. Current flows from the #4 terminal of the ignition switch to #8 terminal of the safety start relay.

Terminal #1 of Ignition Switch

1. Current flows from the #1 terminal of the ignition switch to the fuse panel bussbar, from the bussbar current travels through the fuse ignition, **15 A** fuse.

Fuse Functions

1. The fuse ignition, **15 A** fuse, sends current two directions:
   - Fuel Shutoff Relay, terminals #6 and #9
   - Wire splice SP100 HM
     (Wire slice SP100 HM supplies current to the safety switches)

Safety Switch Functions

1. Range Neutral Safety Switch - When the range selector is placed in the "NEUTRAL" position the neutral range safety switch contacts close, sending current to terminal #6 of the safety start relay.
2. Transmission Clutch Safety Switch - When the transmission clutch pedal is depressed, the transmission clutch safety switch, contacts close, sending current to terminal #2 of the PTO safety switch.
3. PTO Safety Switch - When the main PTO clutch lever is placed in the "OFF" position the PTO safety switch #2 and #4 contacts close, sending current to terminal #3 of the PTO safety relay.
4. Operator Seat Switch - When the operator is in the seat, the operator seat safety switch contacts close, sending current to terminal #5 of the operator safety module and terminal #3 of the operator presence alarm.

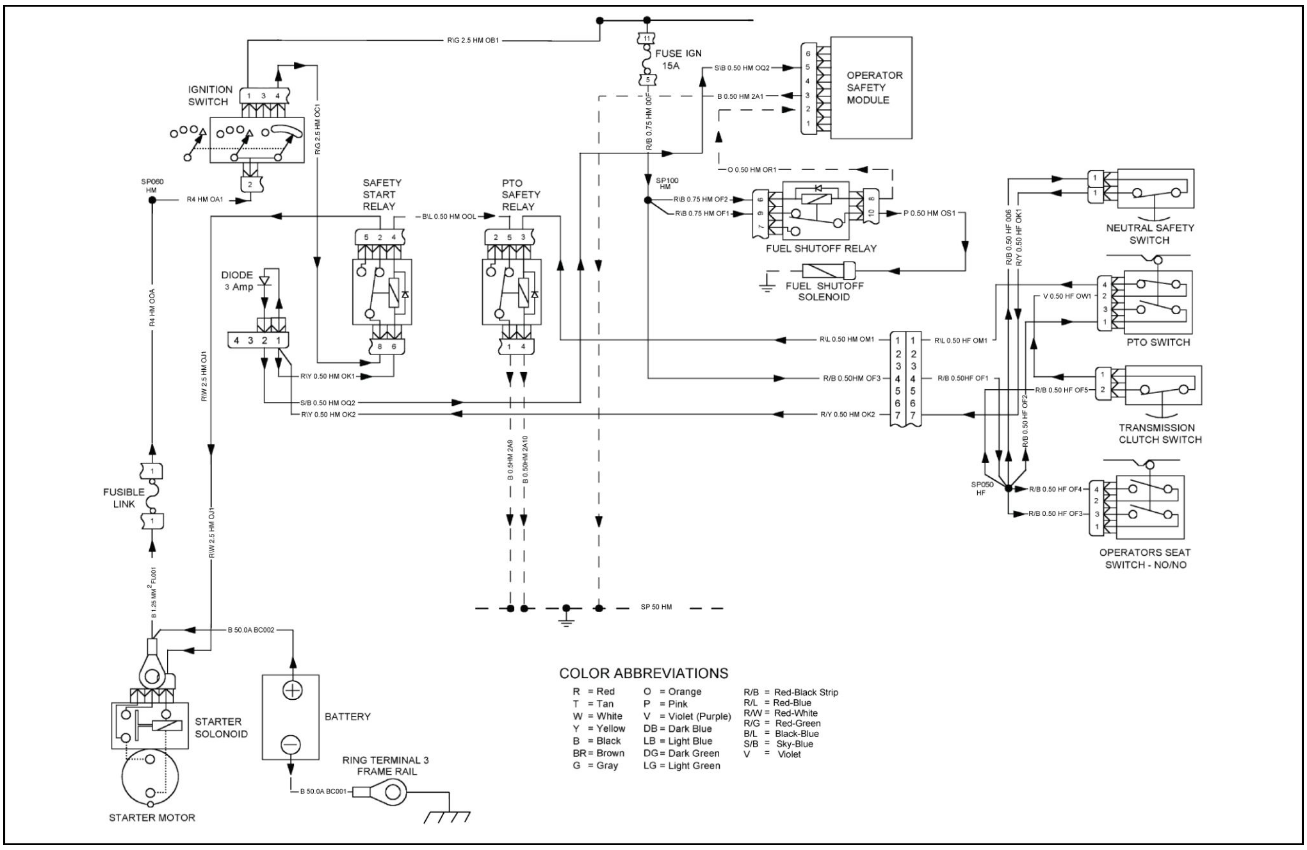
Safety Module Operation

1. With current supplied to terminal #5 of the operator safety module, the module completes the ground path through terminals #2 & #3 of the module. Terminal #2 of module provides completes the ground path for the fuel shutoff relay.

Relays Operation

1. The PTO safety relay has current supplied to terminal #3 (coil side) by the PTO safety switch and a ground source provided to the other side of the coil. The relay energizes latching terminals #1 and #5. Terminal #5 completes the ground path to terminal #4 of the safety start relay.
2. When the ground source is provide to terminal #4 of the safety start relay and current provide to terminal #6 from the neutral/safety switch, the relay latches terminals #2 and #8. Terminal #2 provides current to the starter allowing the engine starter to rotate the engine.
3. Current is supplied to the fuel shutoff relay by the fuse ignition, **15 A** fuse and when the ground path is completed by the #2 terminal of the operator safety module, the fuel shutoff relay energizes, latch terminals #9 and #10 allowing current to flow to the fuel shutoff solenoid. When the solenoid is energized the solenoid plunger retracts and allows fuel to flow to the fuel injection pump.
4. With the injection pump supplied with fuel and the engine rotating, the engine will start.

Wiring harness - Wiring schema Safety circuit start circuit - Operator not present



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NOTE: *The starting circuit is shown with:*

- Operator NOT in the seat
- Transmission clutch pedal depressed
- Transmission range lever in "NEUTRAL" position
- PTO clutch lever in the "OFF" position

1. Current starts at the battery, and flows through the positive (+) battery cable to the engine starter motor.
2. From the starter motor, current flows through the fusible link to the #2 terminal of the ignition switch.
3. When the ignition switch is placed in the "START" position current is transferred across the following ignition switch terminals:
    - #2 to #3 terminals
    - #2 to #4 terminals

Terminal #4 of Ignition Switch

1. Current flows from the #4 terminal of the ignition switch to #8 terminal of the safety start relay.

Terminal #1 of Ignition Switch

1. Current flows from the #4 terminal of the ignition switch to the fuse panel bussbar, from the bussbar current travels through the fuse ignition , **15 A** fuse.

Fuse Functions

1. The fuse ignition, **15 A** fuse, sends current two directions:
   - Fuel Shutoff Relay, terminals #6 and #9
   - Wire splice SP100 HM
     (Wire slice SP100 HM supplies current to the safety switches)

Safety Switch Functions

1. Range Neutral Safety Switch - When the range selector is placed in the "NEUTRAL" position the neutral range safety switch contacts close, sending current to terminal #6 of the safety start relay. Also current is sent to the **3 A** diode, the diode allows current to be sent to terminal #5 of the operator safety module.
2. Transmission Clutch Safety Switch - When the transmission clutch pedal is depressed, the transmission clutch safety switch, contacts close, sending current to terminal #2 of the PTO safety switch.
3. PTO Safety Switch - When the main PTO clutch lever is placed in the "OFF" position the PTO safety switch #2 and #4 contacts close, sending current to terminal #3 of the PTO safety relay.
4. Operator Seat Switch - When the operator is not in the seat, the operator seat safety switch contacts are open, terminating all current at the switch.

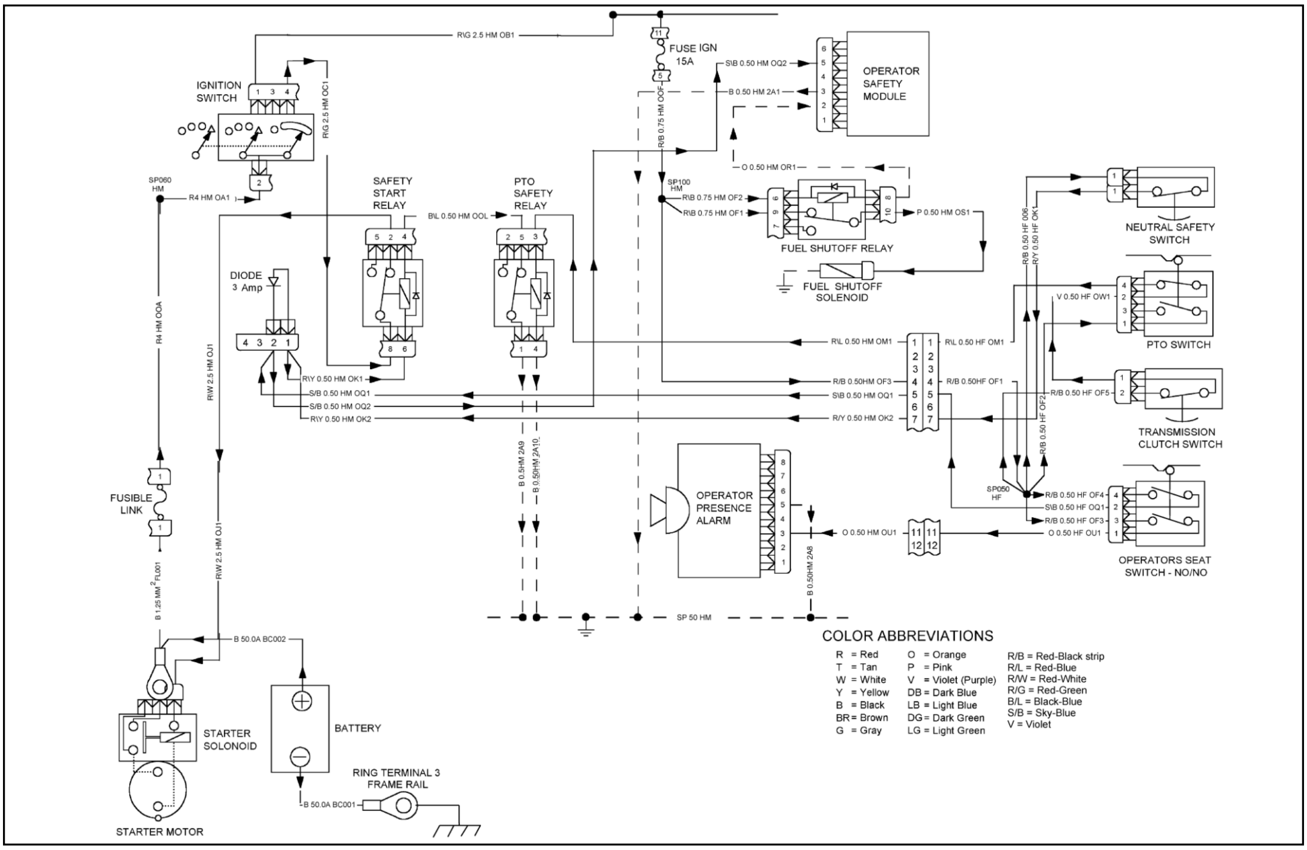
Safety Module Operation

1. With current supplied to terminal #5 of the operator safety module, the module completes the ground path through terminals #2 & #3 of the module. Terminal #2 of module provides completes the ground path for the fuel shutoff relay.

Relays Operation

1. The PTO safety relay has current supplied to terminal #3 (coil side) by the PTO safety switch and a ground source provided to the other side of the coil. The relay energizes latching terminals #1 and #5. Terminal #5 completes the ground path to terminal #4 of the safety start relay.
2. When the ground source is provide to terminal #4 of the safety start relay and current provide to terminal #6 from the neutral safety switch, the relay latches terminals #2 and #8. Terminal #2 provides current to the starter allowing the engine starter to rotate the engine.
3. Current is supplied to the fuel shutoff relay by the fuse ignition, **15 A** fuse and when the ground path is completed by the #2 terminal of the operator safety module, the fuel shutoff relay energizes, latch terminals #9 and #10 allowing current to flow to the fuel shutoff solenoid. When the solenoid is energized the solenoid plunger retracts and allows fuel to flow to the fuel injection pump.
4. With the injection pump supplied with fuel and the engine rotating, the engine will start.

Wiring harness - Wiring schema Safe operation - Operator present



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NOTE: *The operating circuit is shown with:*

- Operator in the seat

1. Current starts at the battery, and flows through the positive (+) battery cable to the engine starter motor.
2. From the starter motor, current flows through the fusible link to the #2 terminal of the ignition switch.
3. When the ignition switch is placed in the "RUN" position current is transferred across the following ignition switch terminals:
    - #2 to #4 terminals

Terminal #4 of Ignition Switch

1. Current flows from the #4 terminal of the ignition switch to the fuse panel bussbar, from the bussbar current travels through the #5, **15 A** fuse.

Fuse Functions

1. The fuse ignition, **15 A** fuse, sends current two directions:
    - Fuel Shutoff Relay, terminals #6 and #9
    - Wire splice SP100 HM
      (Wire slice SP 100 HM supplies current to the operator’s safety switches)

Seat Switch and Operator Safety Module

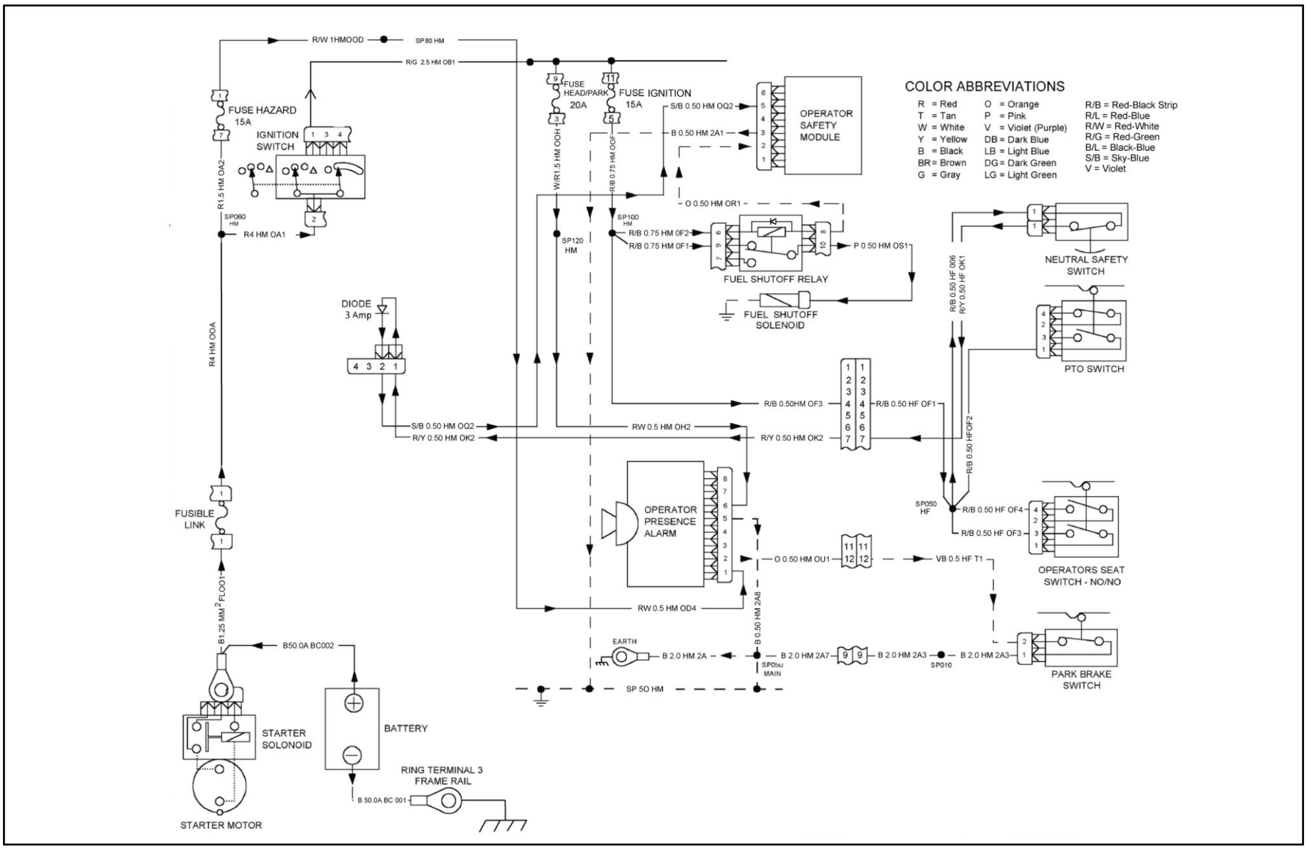
1. When the operator is in the seat, the seat switch closes and connects terminals #2 and #4 of the switch, sending current to terminal #5 of the operator safety module. Also terminals #1 and #3 are connected, sending current to terminal "3" of the operator presence alarm.

2. When current is present at terminal #5 of the operator safety module, the ground path is completed by terminals #2 and #3 of module for the fuel shutoff relay.

Fuel Shutoff Relay

1. When current is provided to the fuel shutoff relay by the **15 A** fuse and ground circuit is completed by the operator safety module, the fuel shutoff relay is energized.
2. When the fuel shutoff relay is energized terminals #9 and #10 are latched providing current to the fuel shutoff solenoid. When the solenoid is energized the solenoid plunger retracts and allows fuel to flow to the fuel injection pump. This allows the engine to remain operating.

Wiring harness - Wiring schema Safe operation - Operator not present, PTO "OFF"



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NOTE: *The operating circuit is shown with:*

- Transmission range lever in "NEUTRAL" position
- Operator NOT in the seat
- Park Brake "ON"
- PTO "OFF"

1. Current starts at the battery, and flows through the positive (+) battery cable to the engine starter motor.
2. From the starter motor, current flows through the fusible link to the #2 terminal of the ignition switch.
3. Current also flows to fuse hazard, **15 A** fuse.
4. When the ignition switch is placed in the "RUN" position current is transferred across the following ignition switch terminals:
   - #2 to #1 terminals

Terminal #1 of Ignition Switch

1. Current flows from the #1 terminal of the ignition switch to the fuse panel bussbar, from the bussbar current travels through the #3, **20 A** and #5, **15 A** fuses.

Fuse Functions

1. The fuse hazard, **15 A** fuse, sends current to the #1 terminal of the operator presence alarm.
2. The fuse head/park, **20 A** fuse, sends current to the #6 terminal of the operator presence alarm.
3. The fuse ignition, **15 A** fuse, sends current two directions:

- Fuel Shutoff Relay, terminals #6 and #9
- Wire splice SP100 HM
  (Wire slice SP100 HM supplies current to the operator’s safety switches)

Safety Switch Functions

1. Range Neutral Safety Switch - When the range selector is placed in the "NEUTRAL" position the neutral range safety switch contacts close, sending current to **3 A** diode, the diode allows current to be sent to terminal #5 of the operator safety module.
2. PTO Safety Switch - When the main PTO clutch lever is placed in the "OFF" position the PTO safety switch #1 and #3 contacts open, terminating current at terminal #1 of the switch.
3. Operator Seat Switch - When the operator not in the seat, the operator seat safety switch contacts are open not allowing current to flow through the switch.
4. Park Brake Switch - When the park brake is applied, the switch contacts close connecting terminals of the switch. The park brake switch completes the ground circuit for terminal #2 of the operator presence alarm.

Safety Module Operation

1. With current supplied to terminal #5 of the operator safety module, by the engine run with stationary rear PTO diode, the module completes the ground path through terminals #2 & #3 of the module. Terminal #2 of module provides completes the ground path for the fuel shutoff relay.

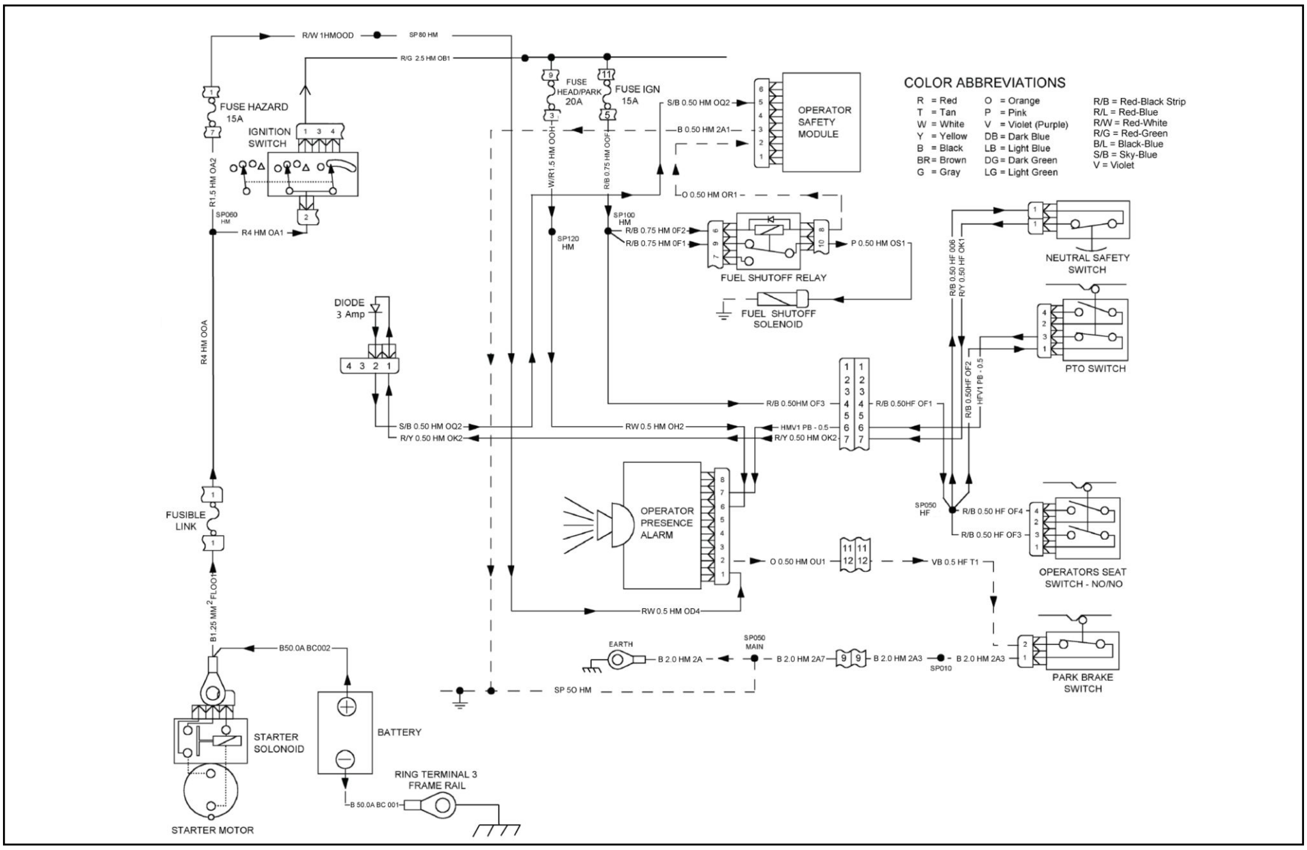
Fuel Shutoff Relay

1. When current is provided to the fuel shutoff relay by the #5, **15 A** fuse and ground circuit is completed by the operator safety module, the fuel shutoff relay is energized.
2. When the fuel shutoff relay is energized terminals #9 and #10 are latched providing current to the fuel shutoff solenoid. When the solenoid is energized the solenoid plunger retracts and allows fuel to flow to the fuel injection pump. This allows the engine to remain operating.

Operator Presence Alarm

1. When current is supplied to terminals #1, #6 and a ground source to terminal #2, the alarm will not sound.

Wiring harness - Wiring schema Safe operation - Operator not present, PTO “ON”



20103305 1

NOTE: *The operating circuit is shown with:*

- Transmission range lever in "NEUTRAL" position
- Operator NOT in the seat
- Park Brake "ON"
- PTO "ON"

1. Current starts at the battery, and flows through the positive (+) battery cable to the engine starter motor.
2. From the starter motor, current flows through the fusible link to the #2 terminal of the ignition switch.
3. Current also flows to #1, **15 A** fuse.
4. When the ignition switch is placed in the "RUN" position current is transferred across the following ignition switch terminals:
    - #2 to #1 terminals

Terminal #4 of Ignition Switch

1. Current flows from the #4 terminal of the ignition switch to the fuse panel bussbar, from the bussbar current travels through the #3, **20 A** and #5, **15 A** fuses.

Fuse Functions

1. The #1, **15 A** fuse, sends current to the #1 terminal of the operator presence alarm.
2. The #3, **20 A** fuse, sends current to the #6 terminal of the operator presence alarm.
3. The #5, **15 A** fuse, sends current two directions:

- Fuel Shutoff Relay, terminals #6 and #9
- Wire splice SP050
  (Wire slice SP050 supplies current to the operator’s safety switches)

Safety Switch Functions

1. Range Neutral Safety Switch - When the range selector is placed in the "NEUTRAL" position the neutral range safety switch contacts close, sending current to **6 A** diode, the diode allows current to be sent to terminal #5 of the operator safety module.
2. PTO Safety Switch - When the main PTO clutch lever is placed in the "ON" position the PTO safety switch #1 and #3 contacts close, sending current to terminal #7 of the operator presence alarm.
3. Operator Seat Switch - When the operator not in the seat, the operator seat safety switch contacts are open not allowing current to flow through the switch.
4. Park Brake Switch - When the park brake is applied, the switch contacts close connecting terminals of the switch. The park brake switch completes the ground circuit for terminal #2 of the operator presence alarm.

Safety Module Operation

1. With current supplied to terminal #5 of the operator safety module, by the engine run with stationary rear PTO diode, the module completes the ground path through terminals #2 & #3 of the module. Terminal #2 of module provides completes the ground path for the fuel shutoff relay.

Fuel Shutoff Relay

1. When current is provided to the fuel shutoff relay by the #5, **15 A** fuse and ground circuit is completed by the operator safety module, the fuel shutoff relay is energized.
2. When the fuel shutoff relay is energized terminals #9 and #10 are latched providing current to the fuel shutoff solenoid. When the solenoid is energized the solenoid plunger retracts and allows fuel to flow to the fuel injection pump. This allows the engine to remain operating.

Operator Presence Alarm

1. When current is supplied to terminals #1, #6 and #7 and a ground source to terminal #2, the alarm will sound for approximately 5 seconds.

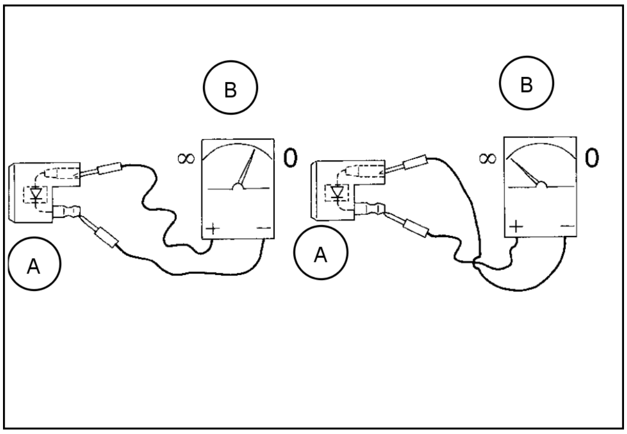
Fuse and relay box - Test Diodes

NOTE: *Use an ohmmeter to test the diode.*

Connect the ohmmeter leads to the diode terminals and observe the meter reading, then reverse the ohmmeter leads and observe the meter reading.

- Continuity should exist in one direction only.

If there is continuity in both directions, or if there is no continuity in either direction, replace the faulty diode. Power should flow in a positive to negative direction.



20097567 1

DIODE-TEST

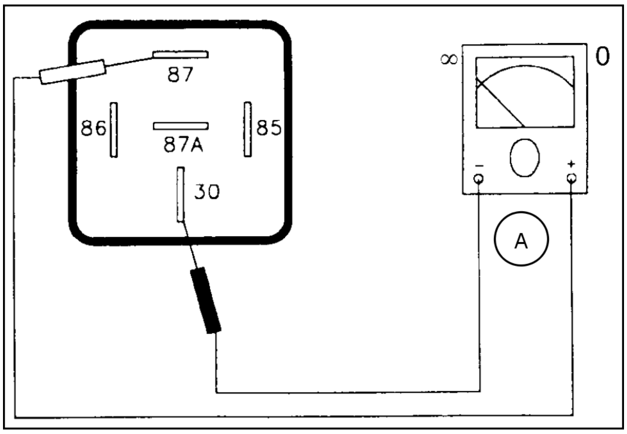
A - DIODE
B - OHMMETER

Fuse and relay box - Test Relays

Testing (Neutral Start)

To test a relay, disconnect it from the circuit.
Use an ohmmeter to verify non-energized conditions.

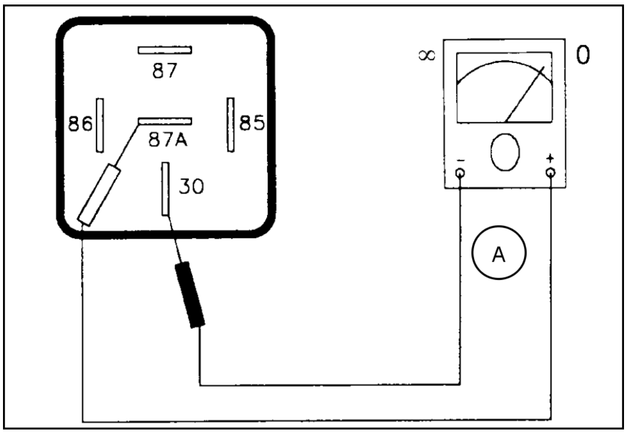
1. Connect the ohmmeter leads to terminals 87 and 30.
   - There will be no continuity between terminals 87 and 30 if the relay is working properly.



20097569 1

A - OHMMETER

2. Connect the ohmmeter leads to terminals 87A and 30.
   - There will be continuity between terminals 87A and 30 if the relay is working properly.

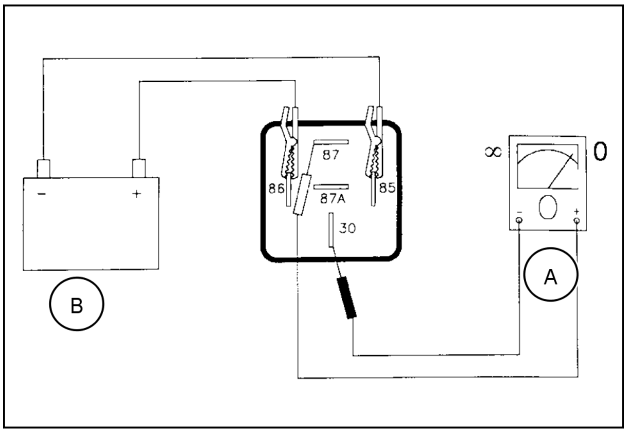


20097570 2

A - OHMMETER

Next use the ohmmeter to verify energized conditions.

1. Energize the coil by applying **12 V** of current across terminals 85 and 86.
2. Connect the ohmmeter leads to terminals 87 and 30.
   - There will be continuity between terminals 87 and 30 if the relay is working properly.

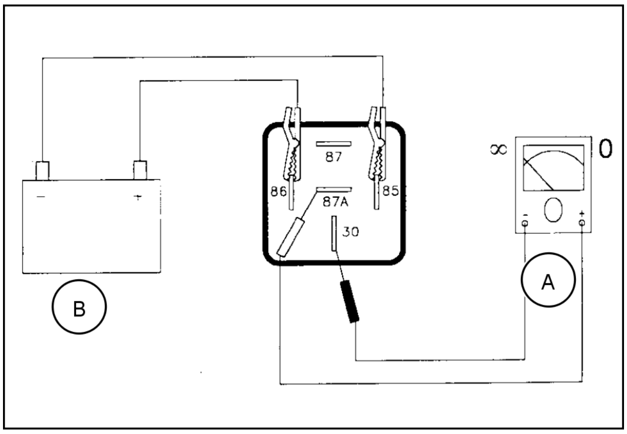


20097571 3

A - OHMMETER
B - BATTERY

3. Connect the ohmmeter leads to terminals 87A and 30.
   - There will be no continuity between terminals 87A and 30 if the relay is functioning properly.

If continuity readings do not match those stated in the above test procedures, replace the relay.



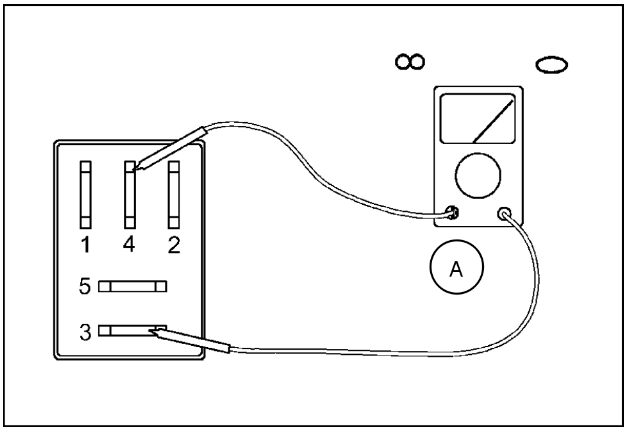
20097572 4

A - OHMMETER
B - BATTERY

Fuse and relay box - Test Relays

Testing - Micro Relays (Fuel Shutoff, PTO Safety Start, Hazard Flasher Cutoff)

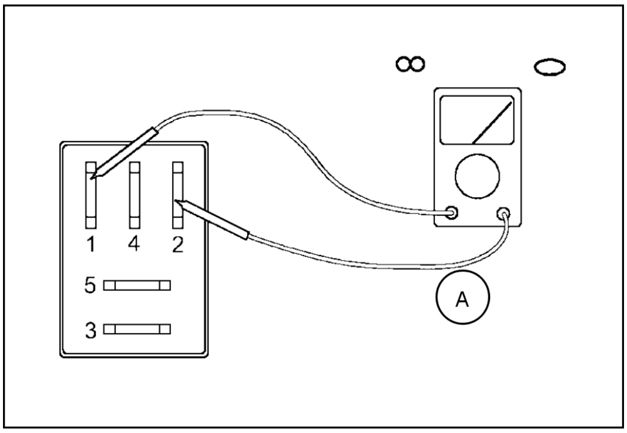
1. Remove the relay suspected of being faulty from the tractor to test.
2. Using an ohmmeter, touch one test probe to terminal 3 and the other test probe to terminal 4.
3. Observe the ohmmeter. There should be little or no resistance, indicating continuity. If there is no continuity, the relay is defective and needs replaced.



20097573 1

A - OHMMETER

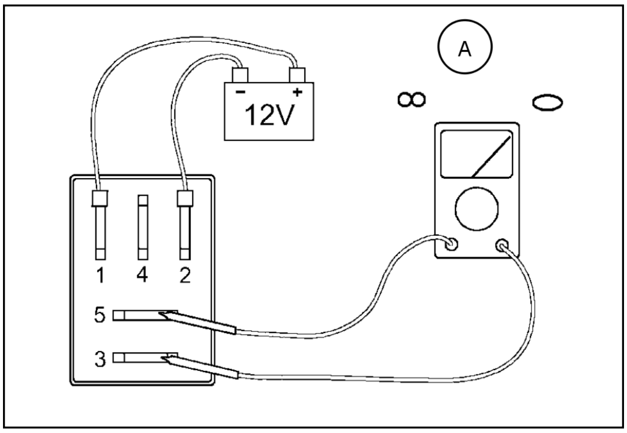
4. If the previous test showed continuity, touch one ohmmeter probe to terminal 1 and the remaining probe to terminal 2.
5. Observe the ohmmeter. The ohmmeter should read approximately **79.5 Ω**. If the reading is not as specified, the relay is defective and needs replaced.



20097574 2

A - OHMMETER

6. If the results from the previous test were good, use a jumper lead to connect the positive (+) terminal of a **12 V** power source to terminal 1 of the relay. Use a jumper lead to connect the negative (-) terminal of a **12 V** power source to terminal 2 of the relay. The relay should now energize.
7. Using an ohmmeter touch a test probe to terminal 3 of the relay. Touch the other ohmmeter test probe to terminal 5.
8. Observe the ohmmeter. There should be little or no resistance, indicating continuity. If there is no continuity, the relay is defective and needs replaced.



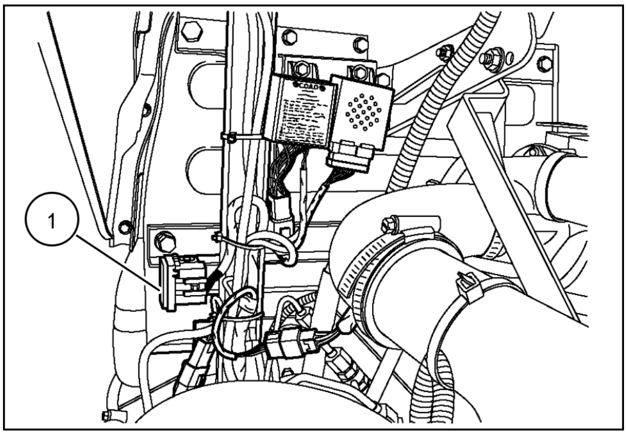
20004392 3

A - OHMMETER

Fuse and relay box - Replace Fuse block

Fuse Replacement

The fuse box, **(1)**, is located on the engine firewall. To check or change fuses pull off the lid to gain access to the fuses.



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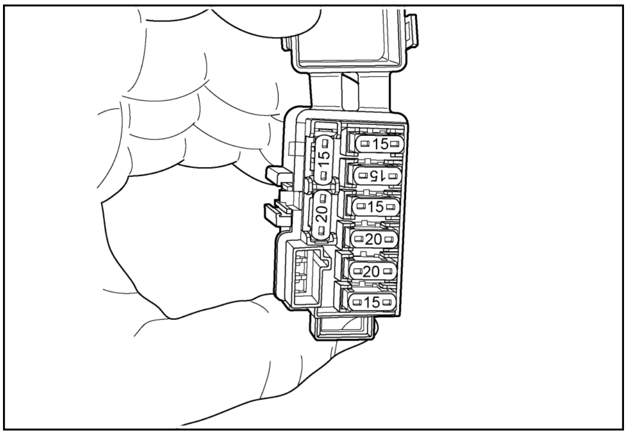
Six fuses are provided in one row. See following table for details of the circuits protected by the fuses.

NOTE: *Do not replace a blown fuse with another of a different rating.*



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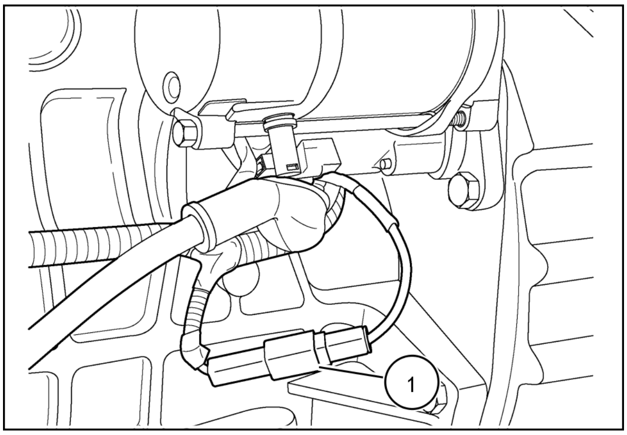
Fuse Identification

Fuse Rating	Circuit
15 A	Instrument panel
15 A	Fuse ignition
15 A	Horn, Turn signals
20 A	Headlights/Park
20 A	Worklight
15 A	Hazard flasher lights
15 A	Spare fuse
20 A	Spare fuse

Fuse and relay box - Replace Fusible link

A fusible link wire, **(1)**, is used to protect the tractor's entire electrical system. If excessive amperage passes through this wire it will melt down so that it will no longer allow current to pass (similar to the way a fuse works). The fusible link wire, **(1)**, is a red wire that goes from the starter terminal to a connector that links into the main wiring harness.



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To replace the fusible link wire:

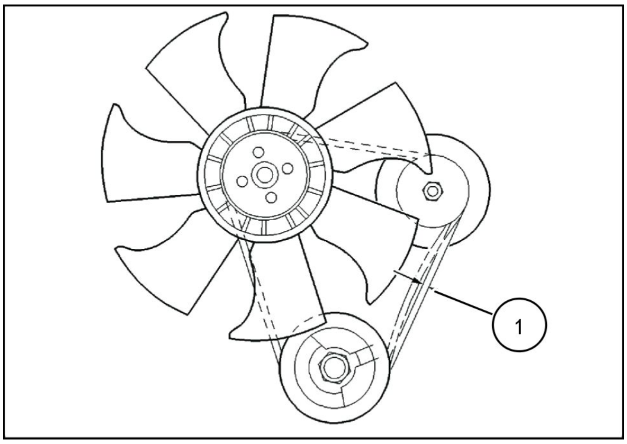
1. Disconnect the battery.
2. Unplug the connector linking the wire to the main wiring harness.
3. Remove the old fusible link wire from the starter terminal.
4. Replace the old fusible link wire with a new one - first attaching to starter terminal, and then connecting into the main wire harness.

NOTE: *Always replace the fusible link wire with the appropriate fusible link wire for this tractor . Fusible link rating is* ***85 A*** *at* ***20 °C*** *(****68 °F****).*

Alternator - Preliminary test

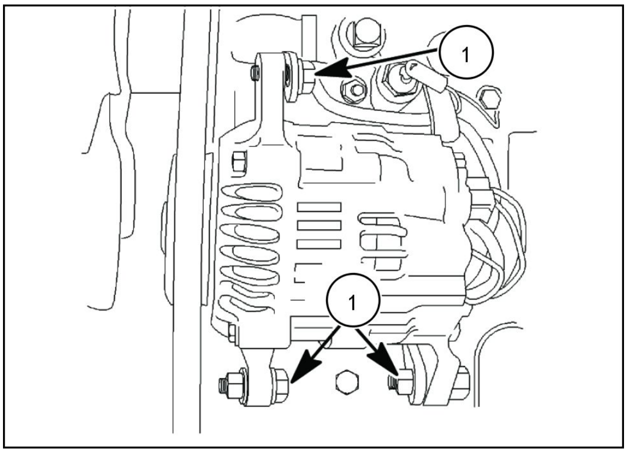
Alternator Drive Belt

1. Check the alternator drive belt deflection by applying **89 - 111 N** (**20 - 25 lb**) of force between the crank pulley and the alternator pulley, **(1)**. Belt deflection should be **10 - 15 mm** (**0.39 - 0.59 in**).



SECT55C04PG9_1A 1

2. If the drive-belt deflection needs adjusted, loosen the adjusting/mounting bolts, **(1)**, and adjust the alternator as needed to obtain proper belt deflection.



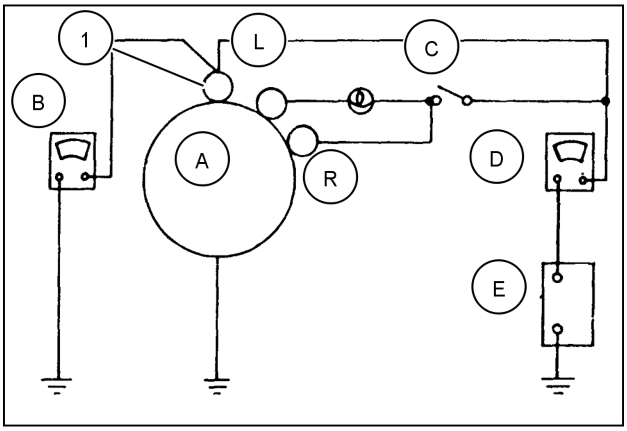
SECT55C04PG9_2D 2

Alternator Output

NOTICE: *Start-up current can exceed ammeter capacity. Do not attempt to start the engine without first shorting the wires between the ammeter leads. Failure to comply could damage testing components.*

NOTE: *Use the following methods if an alternator/charging system analyzer is unavailable.*

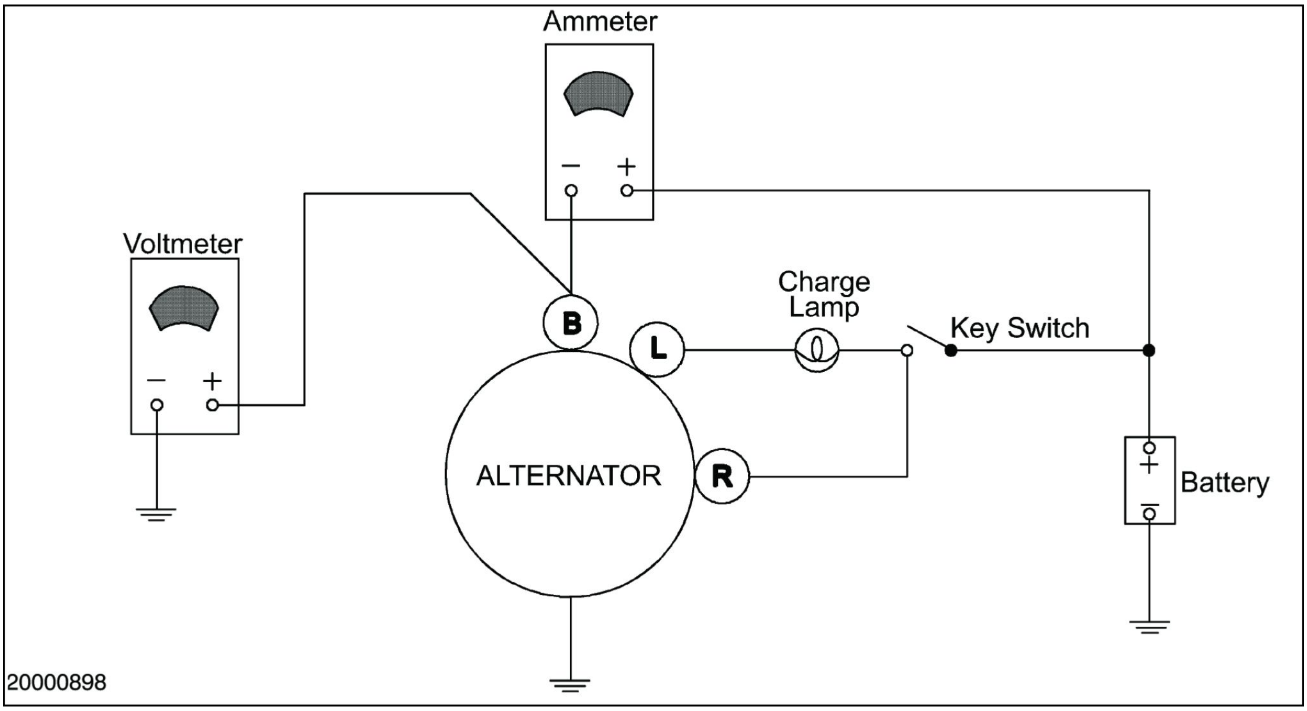
1. Connect a **50 A** capacity test ammeter between the positive (+) battery cable and the key switch.
2. Connect a voltmeter to the battery terminal, **(1)**, of the alternator and to a ground source.



20098354 3

A - ALTERNATOR
B - VOLTMETER
C - KEY SWITCH
D - AMMETER

3. Observe the voltmeter. The meter should indicate battery voltage. If the voltmeter does not read battery voltage, the wiring between the alternator and the battery may be faulty and should be repaired or replaced.
4. Use a jumper wire to short the test ammeter leads and start the tractor engine.
5. After the tractor engine is started, remove the jumper wire between the test leads of the ammeter.
6. Increase the engine speed to approximately **2000 RPM** and observe the ammeter reading.
7. If the ammeter indicates **5 A** or less, observe the voltmeter reading. The voltmeter is indicating adjusting voltage, which is the amount of increased voltage the alternator supplies to the battery. The reading should indicate a higher voltage than what is indicated when voltage is taken at the battery. If the reading is not higher, the alternator is not generating enough voltage and a component may be malfunctioning.
8. If the ammeter indicated more than **5 A**, continue to charge the battery until the ammeter reading falls below **5 A**. If the reading does not fall below **5 A**, test the battery or replace the battery with one that is fully charged.



SECT55C04PG10B 4

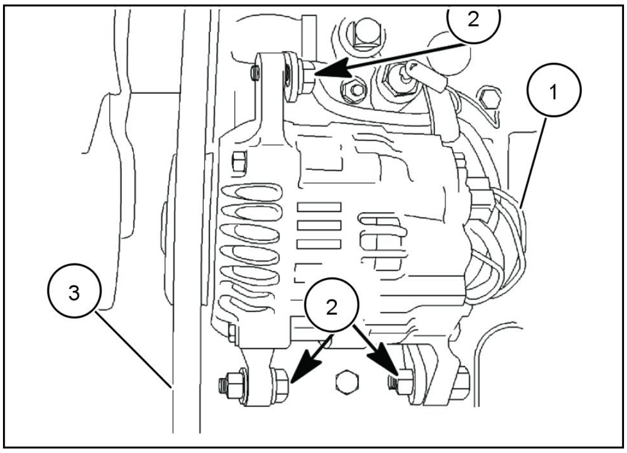
NOTE: *Bench testing the alternator will achieve the best results for the following tests (see alternator bench testing).*

9. If the previous test was satisfactory, open the key switch (OFF) and connect an ammeter between the battery terminal **(B)**, of the alternator and the battery wire, as shown.

10. Connect the positive (+) lead of a voltmeter to the **(B)** terminal on the alternator. Connect the negative (-) lead to a suitable ground. Confirm that the voltmeter indicated battery voltage.
11. Apply the parking brake and start the tractor engine. Turn on all **12 V** powered accessories such as headlight and indicator lights. Immediately raise engine speed to **2000 RPM** or more to record the maximum value indicated on the ammeter.
12. If the amperage value is more than **70 %** of the nominal alternator output, as described in alternator specifications, the alternator is considered to be working satisfactorily.

Alternator - Remove

1. Disconnect the negative (-) battery cable from the negative battery terminal.
2. Disconnect all wiring, **(1)**, from the rear of the alternator.
3. Loosen the alternator mounting bolts, **(2)**, and remove the V-belt, **(3)**, from the alternator drive pulley.
4. Remove the alternator mounting bolts, **(2)**, and remove the alternator from the tractor engine.



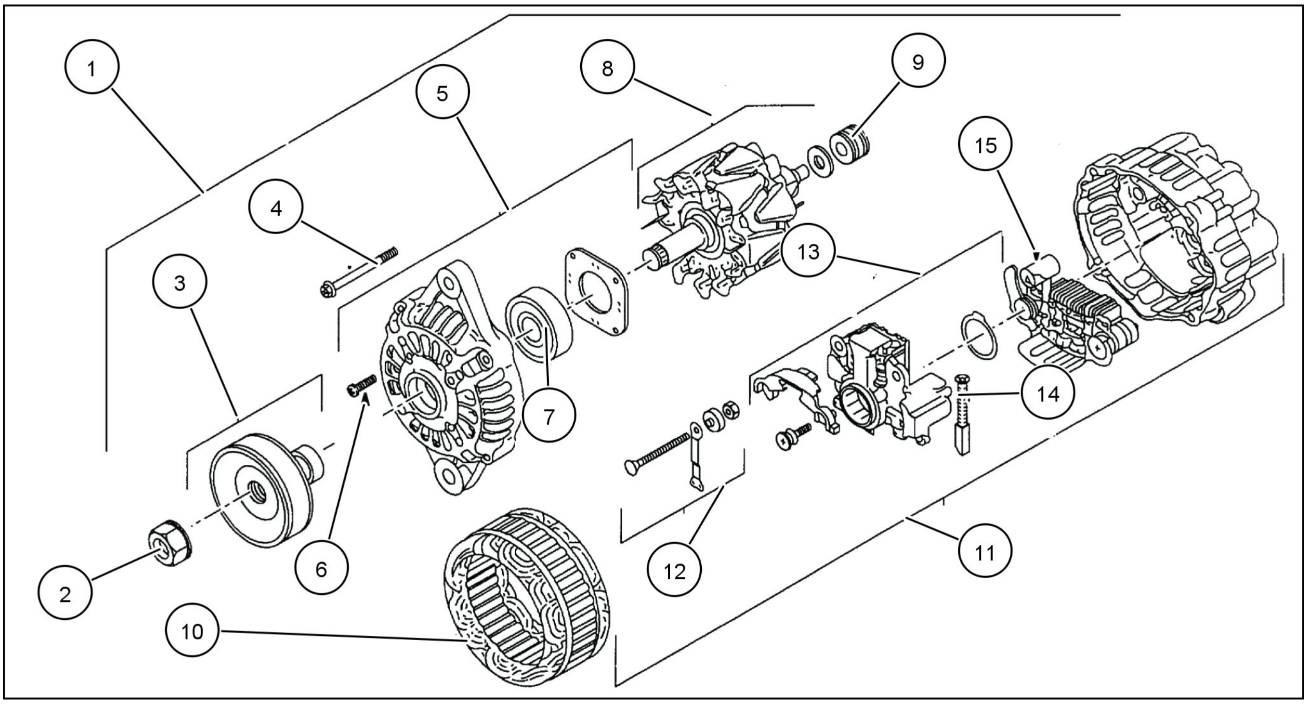
SECT55C04PG9_2D 1

Next operation:
Alternator - Disassemble (A.30.A)

Alternator - Disassemble

***NOTICE:** Heat from a soldering gun can damage diodes. To avoid damage to diodes, use a pair of needle-nose pliers to remove excess heat from the area being soldered. Hold the pliers just below the solder joint to remove excess heat. Use a damp cloth to cool the components once they have been joined or separated. Failure to comply could damage diode.*

Prior operation:
Alternator - Remove (A.30.A)

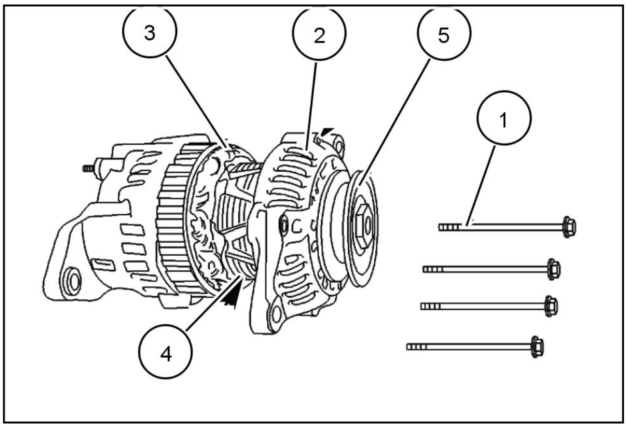


SECT55C04P11_2 1

1. Alternator Assembly	9. Rear Rotor Assembly
2. Pulley Nut	10. Stator
3. Pulley Assembly	11. Rear Alternator Frame Assembly
4. Bolt	12. Terminal Assembly
5. Front Alternator Frame Assembly	13. IC Regulator Assembly
6. Bolt	14. Rotor Brush and Spring
7. Front Rotor Bearing	15. Rectifier
8. Rotor Assembly	

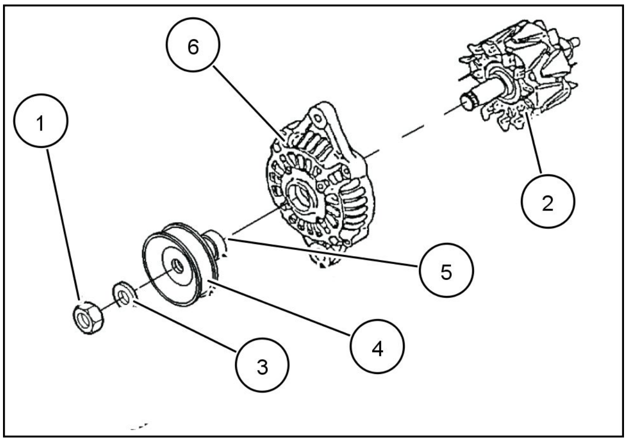
1. Mark the front alternator frame, **(5)**, the rear alternator frame, **(11)**, and the stator, **(10)**, with scribe marks to insure that the alternator is assembled as taken apart.

2. Remove the alternator frame retaining bolts, **(1)**.
3. Carefully separate the front frame, **(2)**, and the rear frame and stator, **(3)**. The rotor assembly, **(4)**, and the pulley, **(5)**, will be removed with the front frame, **(2)**.



SECT55C04PG12_1 2

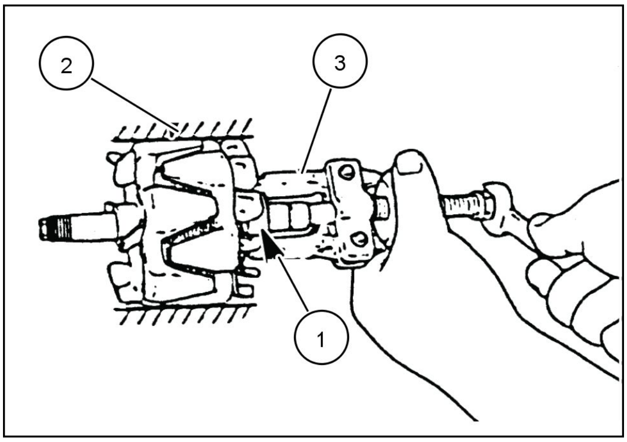
4. To remove the pulley nut, **(1)** use an impact wrench or place the rotor **(2)** into a soft jaw vice and use a wrench. Remove the washer, **(3)** the pulley **(4)** spacer, **(5)** and the front frame **(6)** from the rotor **(2)**.



SECT55C04PG12_2 3

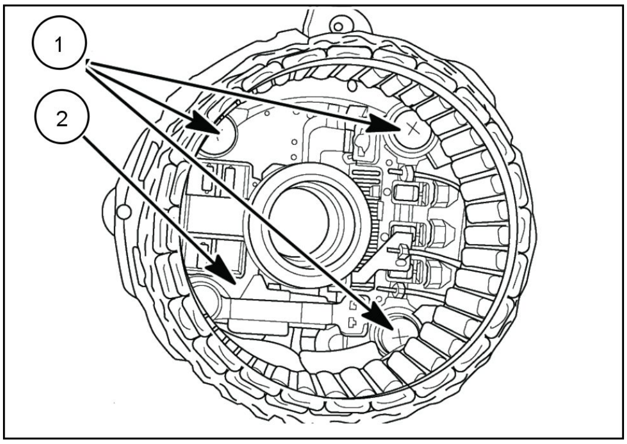
NOTICE: *When removing the rear rotor bearing from the rotor, be sure to apply even pressure to the rear rotor bearing.*

5. The rear rotor bearing, **(1)** may be removed from the rotor **(2)** by using a bearing puller **(3)**.



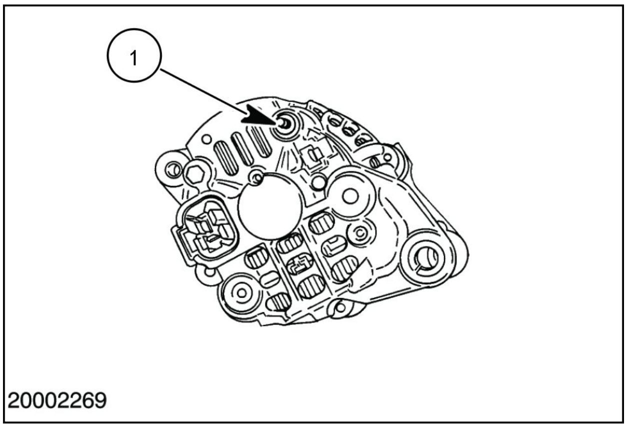
SECT55C04PG12_3 4

6. Remove the screws, **(1)** which secure the regulator/ rectifier assembly **(2)** to the rear alternator frame.



SEC55CH4PG13_1 5

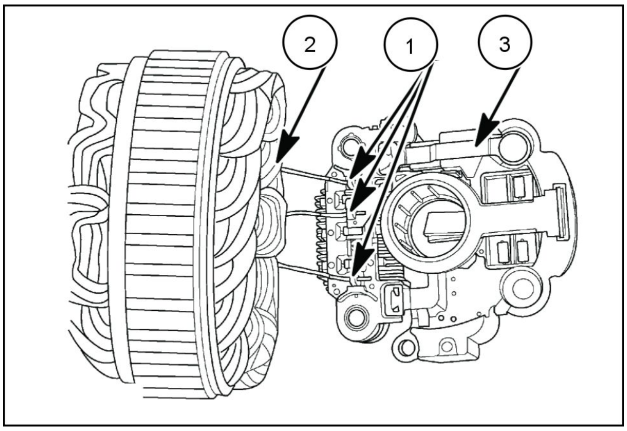
7. Remove the battery terminal nut, **(1)**, from the rear of the alternator frame.
8. Carefully remove the stator and the regulator/rectifier assembly from the rear alternator frame.



SECT55C04PG13_2 6

NOTICE: *Heat from a soldering gun can damage diodes. To avoid damage to diodes, use a pair of needle-nose pliers to remove excess heat from the area being soldered. Hold the pliers just below the solder joint to remove excess heat. Use a damp cloth to cool the components once they have been joined or separated. Failure to comply could damage diode.*

9. Unsolder the stator leads, **(1)**, and remove the stator, **(2)**, from the rectifier/regulator assembly, **(3)**.



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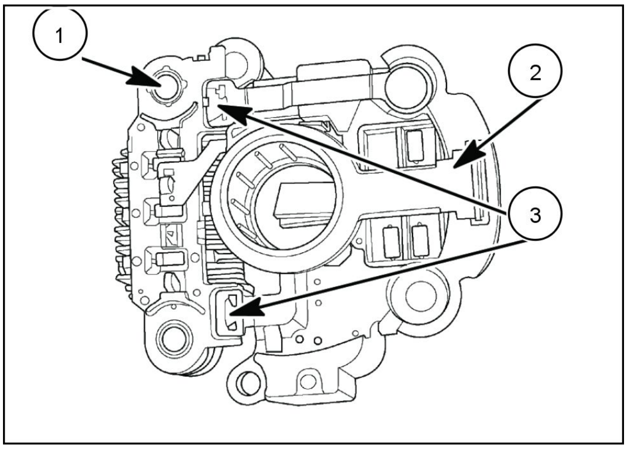
10. Unsolder the IC regulator assembly **(1)**, from the rectifier assembly, **(2)**, at the solder joints, **(3)**.



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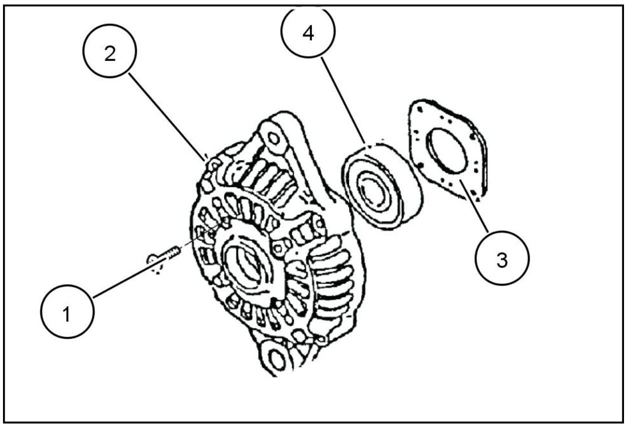
11. Remove the screws, **(1)**, from the front alternator frame, **(2)**. Remove the retaining plate, **(3)**, and the front rotor bearing, **(4)**.



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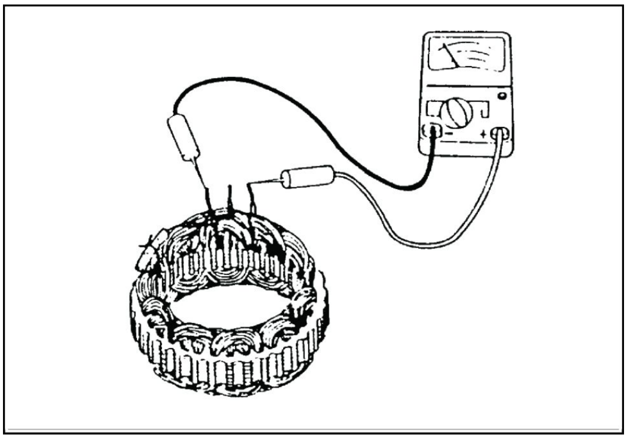
Next operation:
Alternator - Electrical test - Stator (A.30.A)

Alternator - Electrical test - Stator

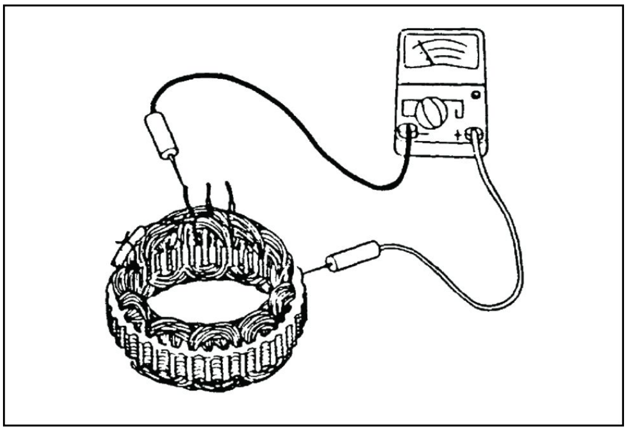
Prior operation:
Alternator - Disassemble (A.30.A)

1. Using an ohmmeter, touch the ohmmeter test probes to different leads of the stator coil.
2. Observe the ohmmeter. The ohmmeter should read a resistance of less than **1 Ω**, for each of the phase wires, indicating continuity.
3. If there is no continuity, inspect the lead wire connection for breaks. The lead wire may be repaired with solder if damage is not excessive. If the lead wire is good, the stator coil is faulty and needs replaced.



SEC55CH4PG15_1 1

4. Using an ohmmeter, touch one of the ohmmeter test probes to the stator coil and the other test probe to the stator core.
5. Observe the ohmmeter. Resistance should be high, indicating no continuity between the coil and the core. If there is continuity, the stator is defective and needs replaced.



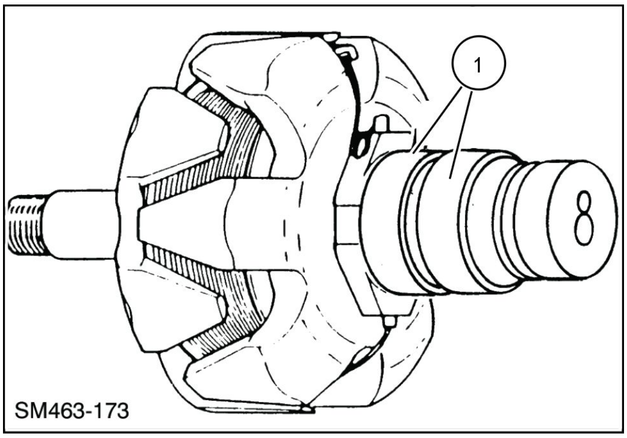
SEC55CH4PG15_2 2

Next operation:
Alternator - Electrical test - Rotor (A.30.A)

Alternator - Electrical test - Rotor

Prior operation:
Alternator - Electrical test - Stator (A.30.A)

1. Inspect the rotor brush contacts, **(1)**, for pitting, roughness and dirt. If necessary use # 600 grit fine sandpaper to clean dirt off of the contacts. If the contacts are pitted or damaged excessively, replace the rotor.



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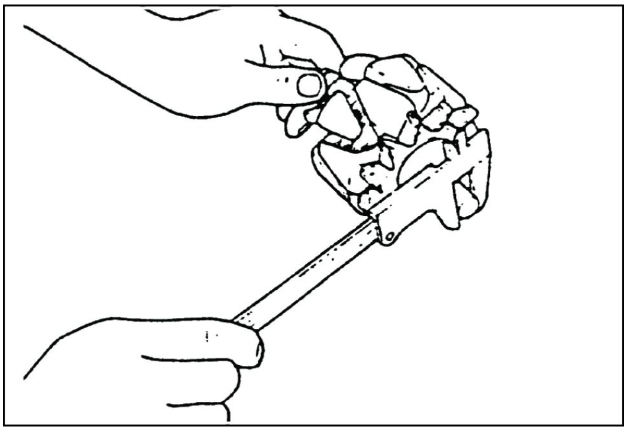
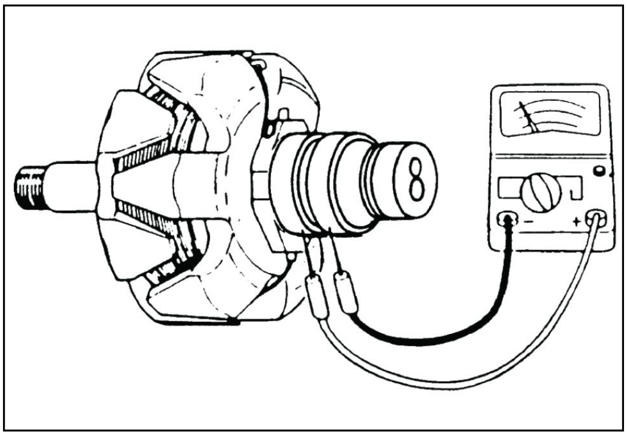
2. Use a suitable measuring device to determine the outer diameter of each brush contact. The minimum outer diameter of the brush contacts is **22.1 mm** (**0.871 in**).



SEC55CH4PG16_2 2

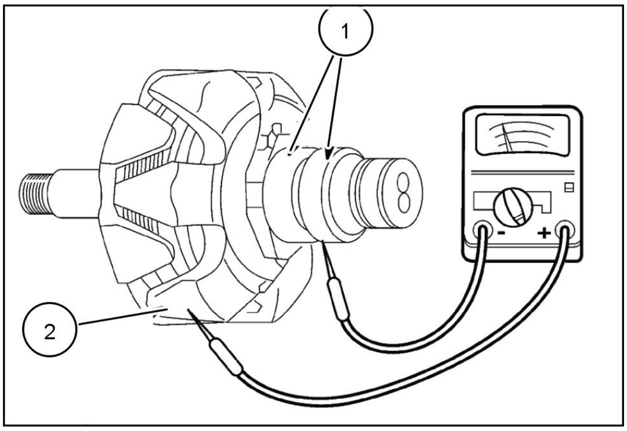
3. Using an ohmmeter, touch one ohmmeter test probe to a brush contact. Touch the other test probe to the remaining brush contact.
4. Observe the ohmmeter. The ohmmeter resistance reading should be approximately **3 Ω**. If the reading is not as specified, the rotor is defective and needs replaced.



SEC55CH4PG16_3 3

NOTICE: *When testing the resistance between the brush contacts and rotor poles, be sure that the ohmmeter test probe touching the rotor pole is not insulated by paint.*

5. Using an ohmmeter, touch one ohmmeter test probe to one of the rotor brush contacts, **(1)** and the other test probe to one of the rotor poles **(2)**.
6. Observe the ohmmeter. Resistance should be high, indicating no continuity between the rotor poles and brush contacts. If there is continuity, the rotor is defective and needs replaced.



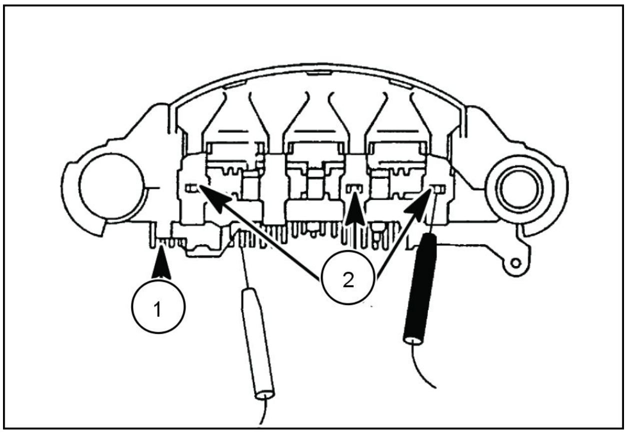
SEC55CH4PG17_1 4

Next operation:
Alternator - Electrical test - Rectifier Assembly (A.30.A)

Alternator - Electrical test - Rectifier Assembly

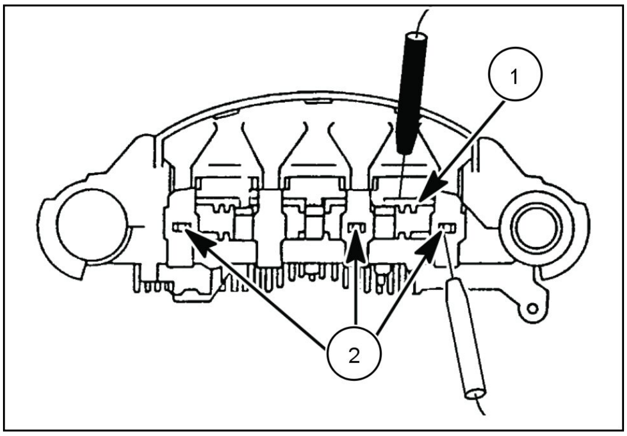
Prior operation:
Alternator - Electrical test - Rotor (A.30.A)

1. Using an ohmmeter, touch the positive (+) test probe to the positive (+) portion of the diode plate, **(1)** and the negative (-) test probe to the stator coil lead connection terminals **(2)**.
2. Observe the ohmmeter for continuity.
3. Now switch the positions of the test probes and observe the ohmmeter for continuity. The ohmmeter should indicate continuity in one direction only. If there is continuity in both directions or no continuity at all, the rectifier assembly is defective and needs replaced.



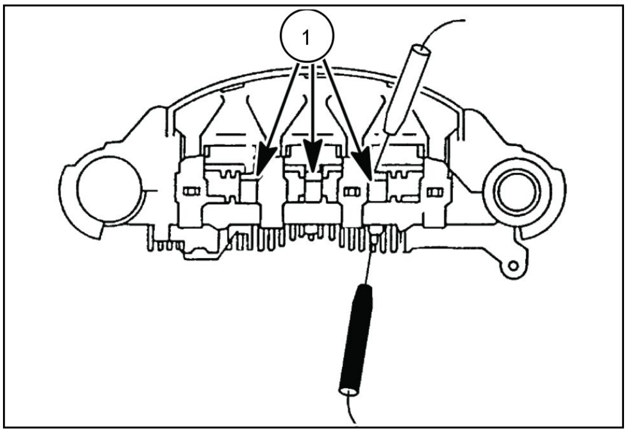
SEC55CH4P17_2 1

4. Using the same procedure described in the three previous steps, test the diodes between the negative (-) portion of the diode plate, **(1)** and the stator lead connections **(2)** Again, replace the rectifier assembly if the diodes test defective.



SEC55CH4P17_3 2

5. Test each of the small diodes, **(1)** touching the positive (+) ohmmeter test probe to one end of a diode and the negative (-) test probe to the opposite end of the diode.
6. Observe the ohmmeter for continuity.
7. Now switch the positions of the test probes and observe the ohmmeter for continuity. The ohmmeter should indicate continuity in one direction only. If there is continuity in both directions, or no continuity at all, the rectifier assembly is defective and needs replaced.



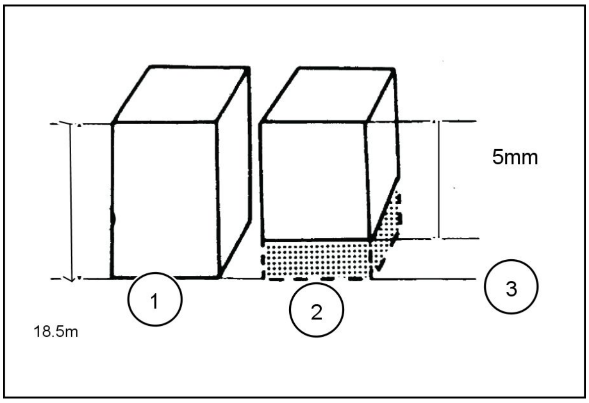
SEC55CH4P18_1 3

Next operation:
Alternator - Inspect (A.30.A)

Alternator - Inspect

Prior operation:
Alternator - Electrical test - Rectifier Assembly (A.30.A)

Alternator Brushes



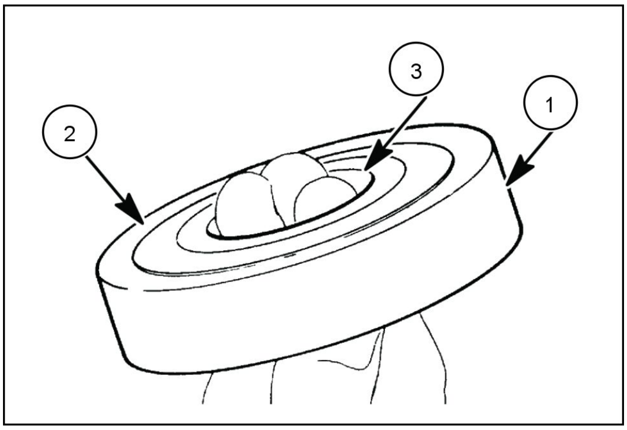
SEC55CH4PG18_2 1

(1) New Brush, (2) Used Brush, and (3) Wear Limit.

1. Carefully clean the alternator brushes with a soft, dry cloth and electrical component cleaner, if available.
2. Inspect the brushes and brush springs for corrosion, damage, stretched springs, or a damaged brush holder. If damaged, replace the brush assembly.
3. Use a suitable measuring device to measure brush wear. The minimum brush length is **5 mm** (**0.020 in**). If either brush is worn beyond specifications, replace the brush assemblies.

Alternator Bearings

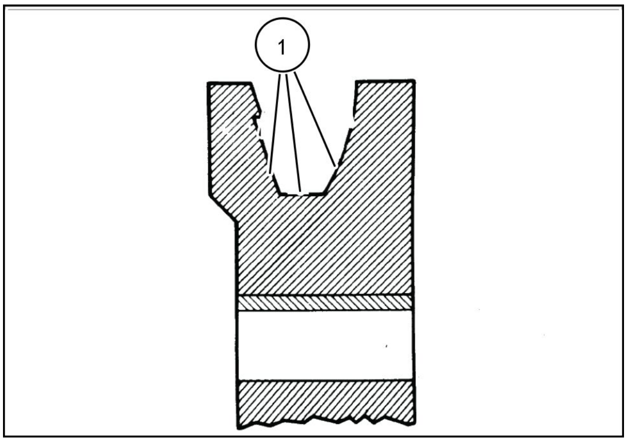
4. Inspect the alternator bearings for smooth operation by spinning the bearing. Replace bearings that are rough and do not rotate smoothly.
5. Inspect the bearings for grease leakage between the bearing seal, **(1)** and races **(2)** and **(3)**.
6. Inspect the inner race, **(3)** and the outer race **(2)** for signs of spinning in the alternator frame or on the rotor shaft.
7. Replace bearings that are damaged in any way.



SEC55CH4P18_3 2

Drive Pulley

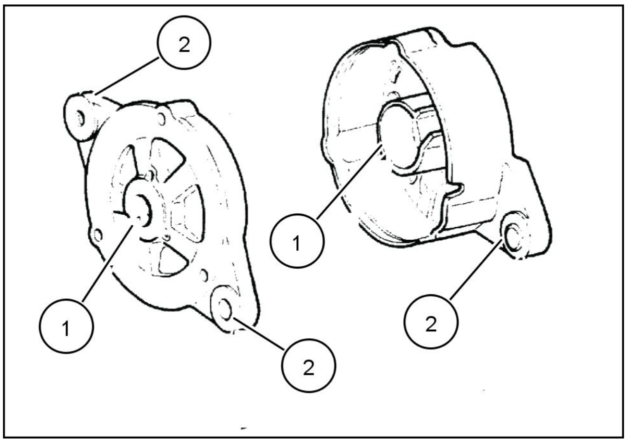
8. Inspect the drive pulley for a worn, bent, cracked, or otherwise damaged belt groove **(1)**.
9. A polished surface in the bottom of the belt groove indicates a worn pulley.



SEC55CH4PG19_1 3

Alternator Frames

10. Inspect the bearing housing bores **(1)**, for scoring, cracks or evidence that the bearing was spinning inside the bore.
11. Inspect the frames for cracked or broken mounting bosses **(2)** or any other distortion or damage.



SEC55CH4PG19_2 4

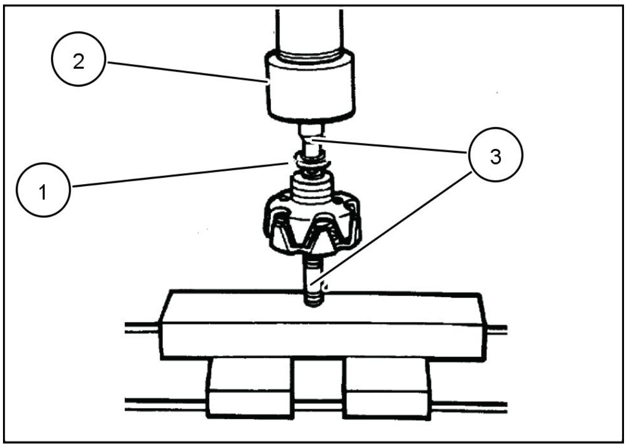
Next operation:
Alternator - Assemble (A.30.A)

Alternator - Assemble

NOTICE: *When installing the rear rotor bearing, be sure that top sleeve used to press the bearing onto the rotor contacts the inner race of the bearing only.*

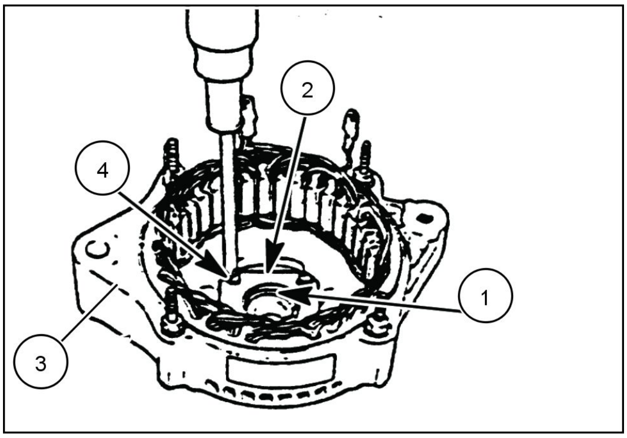
Prior operation:
Alternator - Inspect (A.30.A)

1. Install the rear rotor bearing, **(1)**, and spacer onto the rotor by using a press, **(2)**, and sleeves, such as tubing or **15 mm** (**0.6 in**) deep sockets, **(3)**. The bottom sleeve will support the rotor as the top sleeve presses the rear bearing spacer onto the rotor.



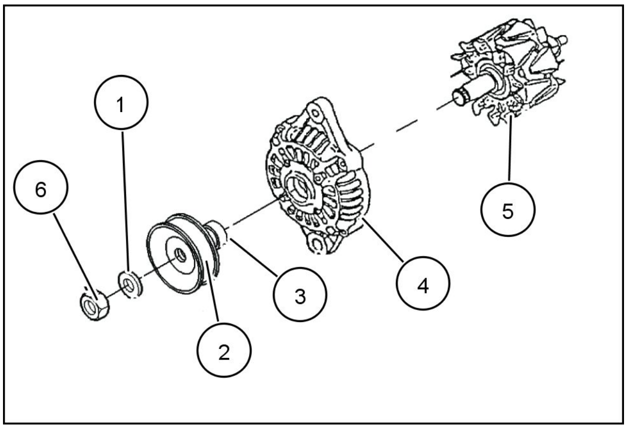
SEC55CH4PG19_3 1

2. Install the front rotor bearing, **(1)** and front bearing retaining plate **(2)** into the front alternator frame, **(3)** and secure using the four retaining screws **(4)**.



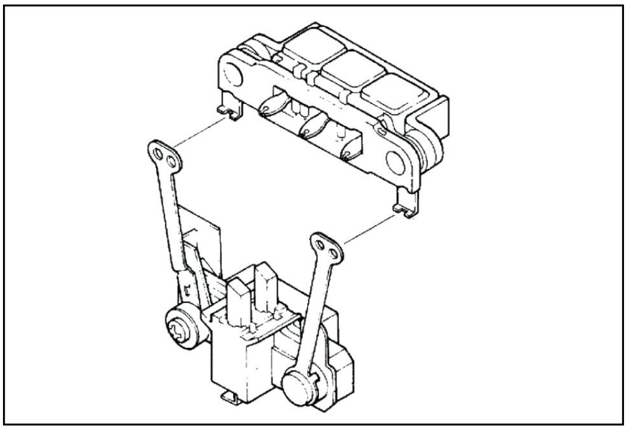
SEC55CH4PG20_1 2

3. Install the washer **(1)**, pulley, **(2)**, spacer, **(3)** and front frame **(4)** onto the rotor **(5)**.
4. To install the pulley nut **(6)** use an impact wrench or place the rotor **(5)** into a soft jaw vice and use a wrench to tighten the pulley assembly to the rotor.



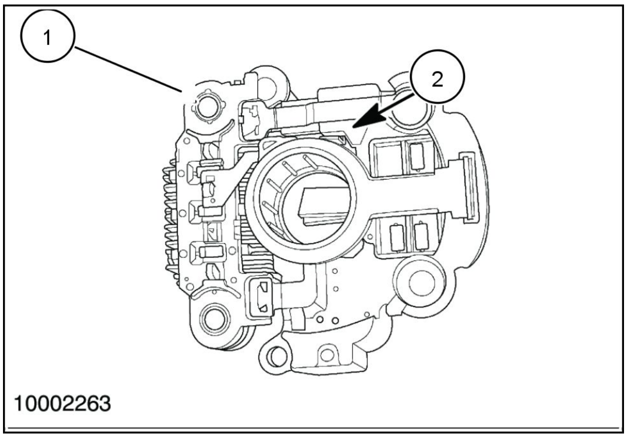
SEC55CH4PG20_2 3

5. Use the following guidelines when soldering alternator components.
   - Clean all terminals to be soldered and remove excess solder.
   - Preheat the soldering iron and use rosin-core solder to solder terminals and/or wires. To avoid damage to the rectifier diodes, use a pair of needle nose pliers to remove excess heat from the area being soldered. Hold the pliers just below the solder joint on the rectifier to remove excess heat.
   - Make good, solid, solder joints for best alternator performance.
   - After soldering, quickly cool the solder joint with a damp cloth.



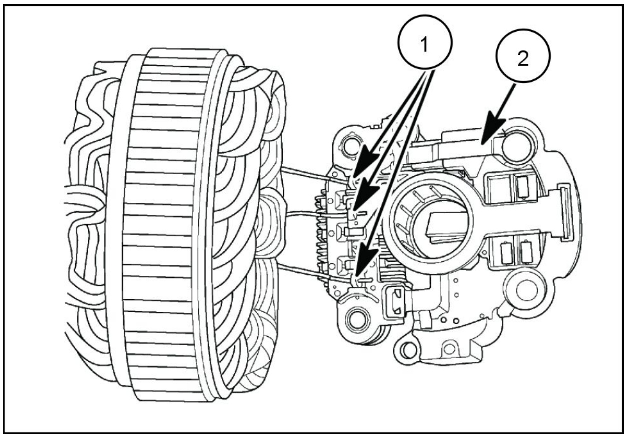
SEC55CH4PG21_1 4

6. Solder the IC regulator, **(1)** and rectifier **(2)** together.



SEC55CH4PG21_2 5

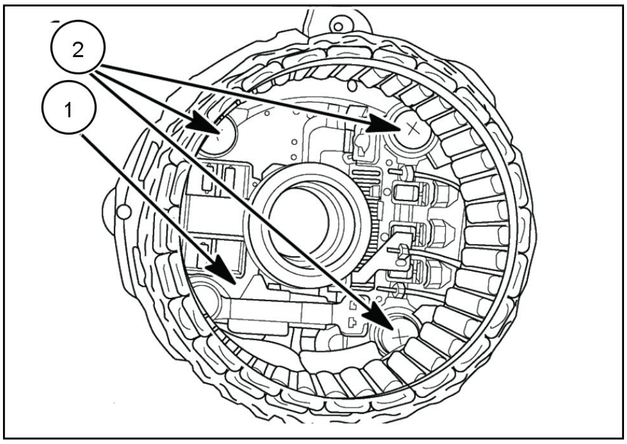
7. Solder the stator leads, **(1)** to the terminals on the rectifier/regulator assembly **(2)**.



SEC55CH4PG21_3 6

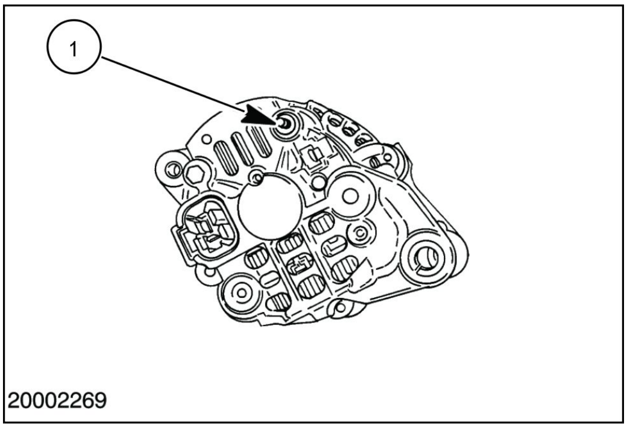
NOTICE: *Secure the regulator/rectifier assembly to the rear alternator frame before pressing the stator into the rear frame.*

8. Secure the regulator/rectifier assembly, **(1)** the rear alternator frame using the retaining screws **(2)**. Manually press the stator assembly into the rear alternator frame.



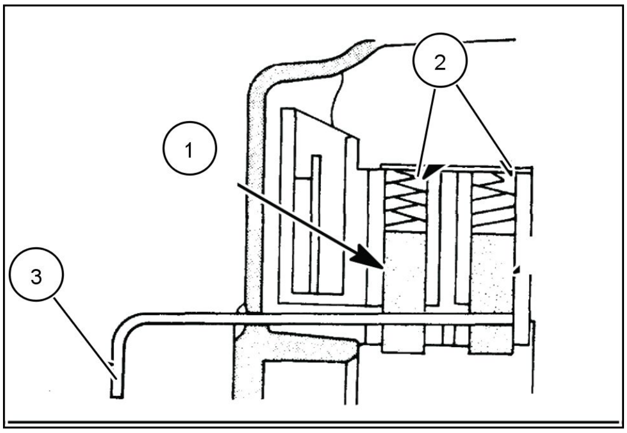
SEC55CH4P13_1 7

9. Install the battery terminal nut **(1)** to the rear of the alternator frame.



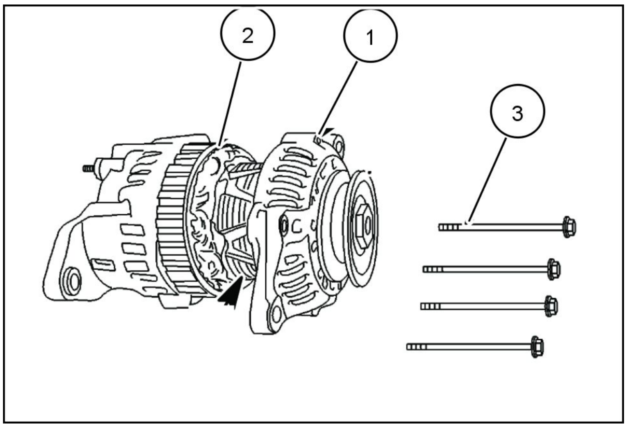
SECT55C04P13_2 8

10. Push the brushes **(1)** and springs, **(2)** to the brush holder and insert a piece of wire **(3)** through the rear of the alternator frame and into the brush holder to hold the brushes out of the way while the alternator halves are being assembled.



SEC55CH4PG22_3 9

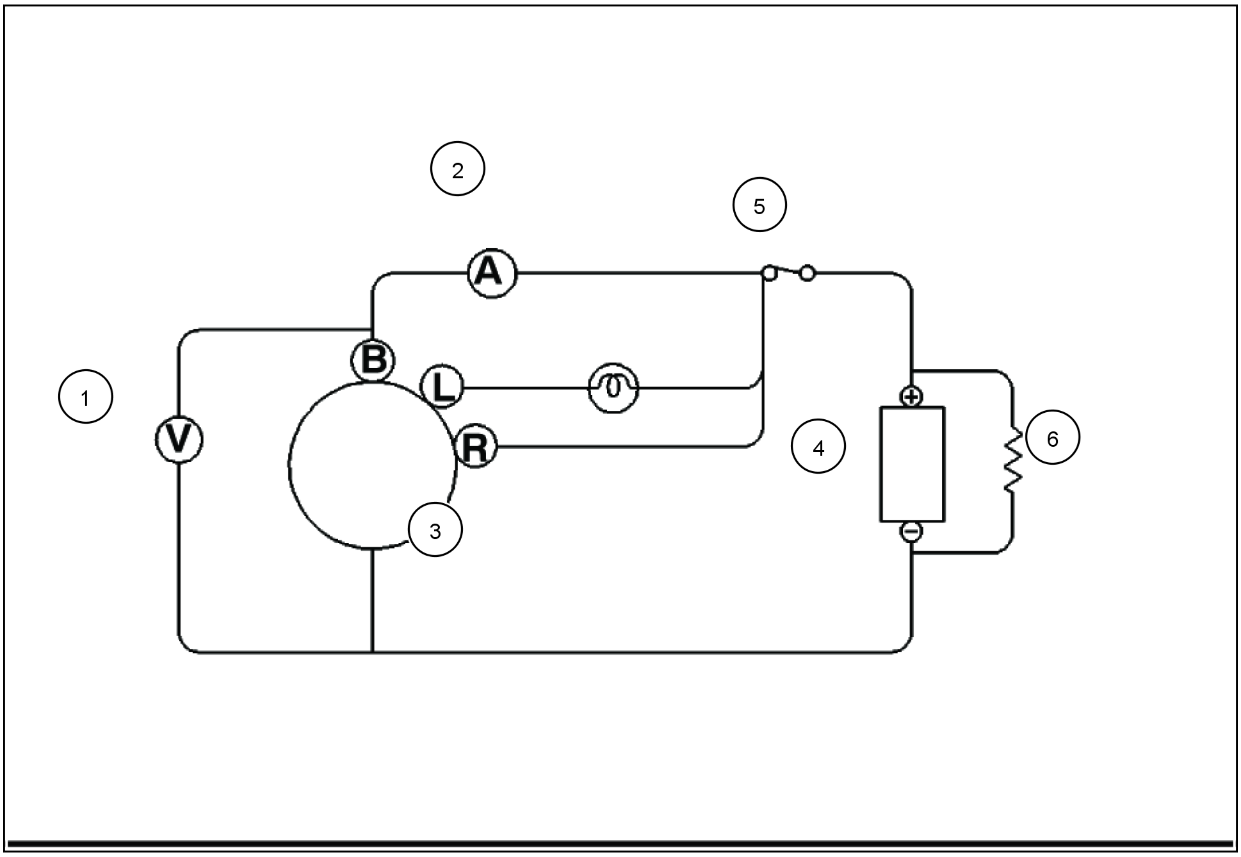
11. Assemble the front alternator frame, **(1)** and rear alternator frame **(2)** together. Be sure to align the scribe marks made when the alternator was disassembled to insure proper reassembly. Use the bolts, **(3)** secure the front and rear frames together.



SECT55C04P12_1 10

Next operation:
Alternator - Electrical test Bench Check (A.30.A)

Alternator - Electrical test Bench Check



(1) Voltmeter (2) Ammeter (3) Alternator (4) Battery (5)Switch (6)Load Resistor

Prior operation:
Alternator - Assemble (A.30.A)

1. Connect the alternator to a testing circuit, as shown. Set the load resistance to zero

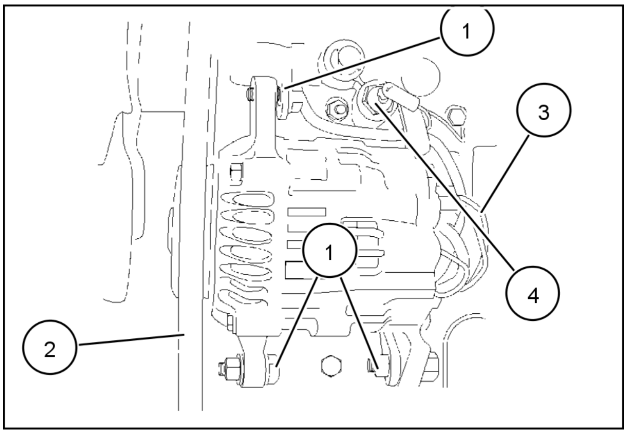
NOTICE: *Alternator rotation direction is clockwise, as viewed looking at the pulley.*

2. Slowly increase the alternator rotational speed and observe the voltage reading indicated on the voltmeter.
3. If the voltage is uncontrolled when increasing alternator speed and increases above **15.5 V**, disassemble and check the alternator for malfunctioning components.
4. If the voltage reading is below **15.5 V**, set alternator's rotational speed to **5000 RPM** and set the load resistance to achieve maximum output from the alternator.
5. If the amperage value is more than **70 %** of the nominal alternator output as described in alternator specifications, the alternator is considered to be working satisfactorily.

Next operation:
Alternator - Install (A.30.A)

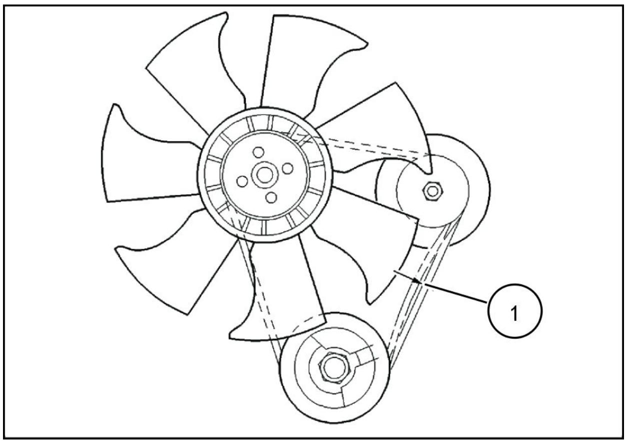
Alternator - Install

1. Install the temperature sender **(4)**, and torque to **25 - 29 N·m** (**18 - 21.7 lb ft**).
2. Align the alternator with the alternator mounting holes located on the engine block and brackets. Use the adjusting/mounting bolts, **(1)** to secure the alternator to the mounting brackets. Be sure to install the v-belt **(2)**, into the drive pulley.
3. Connect all wire terminals, **(3)** rear of the alternator.



20097781 1

4. Adjust the alternator drive belt deflection by loosening the mounting bolts and moving the alternator into or away from the engine block. Belt deflection should be **10 - 15 mm** (**0.39 - 0.59 in**) when applying **89 - 111 N** (**20 - 25 lb**) of force between the crank pulley and the alternator pulley **(1)**.



SECT55C04P9_1 2

Battery - Check

NOTE: *Check the battery electrolyte level after every 50 hours of operation.*

⚠ WARNING ⚠

An explosive gas is produced inside the battery when the alternator is charging. Always check the electrolyte level with the machine engine off and key removed. Do not use an exposed flame and do not smoke when checking the battery electrolyte level. Wash your hands after handling battery components. Failure to comply could result in death or serious injury.

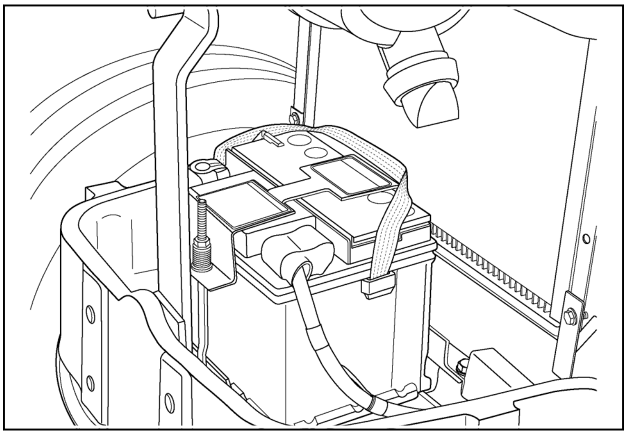
M1581

To check the battery electrolyte level

1. Clean the top of the battery, then remove the vent plugs.
2. If the electrolyte level is low, add distilled water. The correct level is when the liquid is **6.35 mm** (**0.25 in**)above the plates.

NOTE: *Keep distilled water in a nonmetallic container that is clean and well-covered.*

3. Install the vent plugs after making sure the vent holes are not blocked. After adding water at below freezing temperatures, run the engine for a period of time. This allows the battery to charge, preventing the water from freezing.



86072018 1

Battery - Remove

⚠ CAUTION ⚠

Shock hazard! Disconnect the negative (-) battery cable from the battery before working on any electrical system component. Electrical shock or damage to system components may occur. Some testing requires 12-volt power; use care during these tests. Failure to comply could result in minor or moderate injury.

M1678

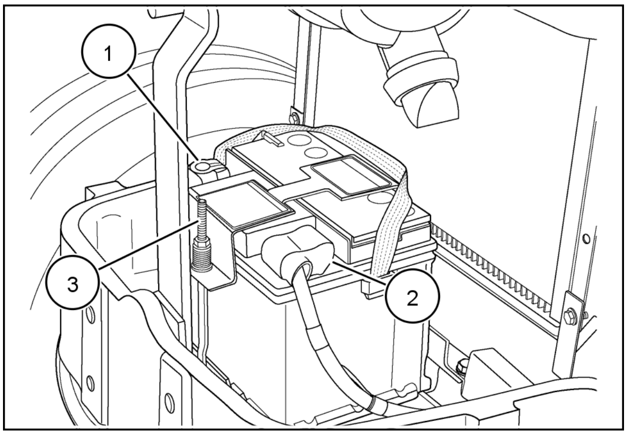
1. Unlatch and raise the hood to gain access to the battery.

⚠ WARNING ⚠

Shock hazard! When removing the battery terminal for any reason, do not allow the negative and positive cables to touch, or to make contact with the battery. Battery posts, terminals, and related accessories contain lead and lead compounds. Wash hands after handling. Failure to comply could result in death or serious injury.

M1704

2. Remove the negative (-) cable, **(1)**, from the negative (-) terminal on the battery.
3. Remove the positive (+) cable, **(2)**, from the positive (+) terminal on the battery.
4. Remove the nut, washer and J-bolt, **(3)**, which secures the battery to the tractor frame.
5. Remove the battery from the tractor.



86072018 1

Next operation:
Battery - Install (A.30.A)

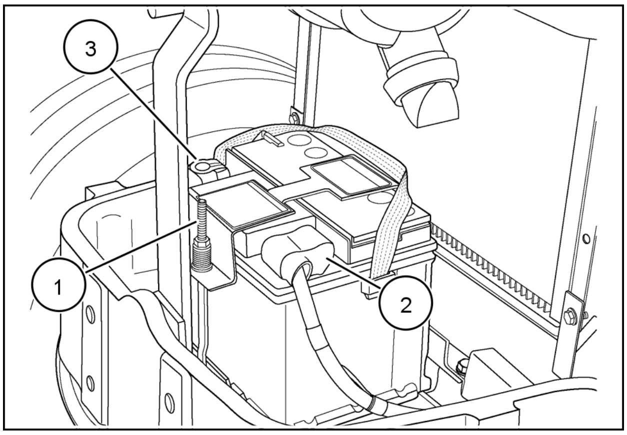
Battery - Install

Prior operation:
Battery - Remove (A.30.A)

1. Check the battery for cleanliness, especially around the terminals. Clean the area where the battery mounts to the tractor frame to prevent debris from piercing the body of the battery.
2. Check the vent caps for proper installation and tightness.
3. Ensure that no leakage occurs from the battery.
4. Install the battery squarely into position before securing with strap, and J-bolt, **(1)**.
5. Connect the positive (+) terminal, **(2)**, then the negative (-) terminal, **(3)**.

NOTE: *Coat the battery terminal clamps with petroleum jelly or equivalent. Do not use conventional lubricants as electrolyte corrosion may occur.*

6. Check battery terminal connections for correct polarity and tightness. Do not overtighten. Install dust covers over terminals, (where installed).



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ELECTRICAL POWER SYSTEM - Troubleshooting Charging circuit

Problem	Possible Cause	Correction
Charge light remains illuminated	Faulty alternator component.	Test alternator and repair a necessary.
	Short circuit to ground between alternator and warning lamp.	Check wiring and repair as necessary.
Charge light does not illuminate	Blown fuse panel, **15 A** instrument panel fuse.	Inspect **15 A** fuse and replace as necessary.
	Faulty charge indicator bulb.	Inspect indicator bulb and replace as necessary.
	Open charge light circuit.	Inspect connections, grounds, and wiring for charge circuit and repair as necessary.
Insufficient or no battery charge, hard starting, or dim indicator light	Battery charge less than 75%.	Test battery. Charge, add water, or replace as necessary.
	Fan belt slipping.	Check fan belt tension, adjust as necessary.
	Loose wiring connections.	Check wiring connections for charge circuit, repair as necessary.
	Continuity fault in external wiring.	Check wiring harness and repair as necessary.
	Blown fuse panel, **15 A** alternator excitation fuse.	Inspect **15 A** fuse and replace as necessary.
Battery failure, frequent burnout of lamps and fuses	Overcharge condition.	Check alternator voltage output and repair as necessary.
	Ground circuit for alternator short-circuited.	Check alternator wiring and connections and repair as necessary.

Alternator - Troubleshooting

Problem	Possible Cause	Correction
No charging	Wiring: Loose connection or short circuit.	Repair.
	Alternator: Loose connection, no ground, or short circuit.	Repair or replace.
	Alternator: Defective rectifier.	Replace.
	Regulator: Defective regulator.	Replace.
	Regulator: Loose connection of alternator or regulator.	Repair or replace.
Insufficient charging	Wiring: Loose connection or short circuit.	Repair.
	Alternator: Loose drive belt.	Repair.
	Alternator: Short in rotor coil.	Replace.
	Alternator: Short in stator coil.	Replace.
	Alternator: Defective rectifier.	Replace.
	Alternator: Insufficient brush contact.	Repair or replace.
	Regulator: Defective regulator.	Replace.
	Regulator: Loose connection of alternator and regulator.	Repair.
	Battery: Defective Battery.	Replace.
Overcharge	Battery: Internal short.	Replace.
	Regulator: Defective regulator.	Replace.
Unstable Charging Circuit	Wiring: Loose connection or open wire.	Repair or replace.
	Alternator: Loose drive belt.	Repair.
	Alternator: Short in rotor coil.	Replace.
	Alternator: Short in stator coil.	Replace.
	Alternator: Broken brush or spring.	Replace.
	Alternator: Loose connection.	Repair.
	Regulator: Defective Regulator.	Replace.
	Regulator: Loose connection at alternator and regulator.	Repair or replace.
Abnormal Noise from Alternator	Alternator: Loose mounting hardware.	Repair.
	Alternator: Defective bearings.	Repair or replace.
	Alternator: Rotor core and stator in contact.	Replace.
	Alternator: Defective diode.	Replace.
	Alternator: Short in stator coil.	Replace.

Wiring harness - Troubleshooting Safety start circuit - Operator present

Problem	Possible Cause	Correction
Starter motor will not energize	Insufficient battery charge.	Test battery. Charge, add water, or replace as necessary.
	Blown fusible link.	Inspect and replace fusible link as necessary.
	Defective key switch.	Test key switch and replace as necessary.
	Defective PTO safety or safety start relay.	Test relays and replace as necessary.
	Malfunctioning safety start switch.	Test neutral range, main PTO transmission clutch, and seat safety start switches for adjustment, proper operation, and faulty ground circuits.
	Malfunctioning starter motor.	Test starter motor and repair or replace as necessary.
Starter motor energizes, but fails to start engine (lacks exhaust smoke)	Blown fuse ignition, **15 A** fuse.	Replace fuse.
	Defective operator safety module.	Test module and replace as necessary.
	Defective fuel shutoff relay.	Test fuel shutoff relay and replace as necessary.
	Malfunctioning fuel shutoff solenoid.	Test fuel shutoff solenoid and replace as necessary.

Wiring harness - Troubleshooting Safety start circuit - Operator not present

Problem	Possible Cause	Correction
Starter motor will not energize	Insufficient battery charge.	Test battery. Charge, add water, or replace as necessary.
	Blown fusible link.	Inspect and replace fusible link as necessary.
	Defective key switch.	Test key switch and replace as necessary.
	Defective PTO safety or safety start relay.	Test relays and replace as necessary.
	Malfunctioning safety start switch.	Test neutral range, main PTO transmission clutch, and seat safety start switches for adjustment, proper operation, and faulty ground circuits.
	Defective start circuit diode.	Test start circuit diode and replace as necessary. Operator must be out of seat for test.
	Malfunctioning starter motor.	Test starter motor and repair or replace as necessary.
Starter motor energizes, but fails to start engine (lacks exhaust smoke)	Blown fuse ignition, **15 A** fuse.	Replace fuse.
	Defective operator safety module.	Test module and replace as necessary.
	Defective fuel shutoff relay.	Test fuel shutoff relay and replace as necessary.
	Malfunctioning fuel shutoff solenoid.	Test fuel shutoff solenoid and replace as necessary.

Wiring harness - Troubleshooting Safe Operation - Operator Present

Problem	Possible Cause	Correction
Engine does not continue to run while operator is seated	Defective seat safety switch.	Test seat safety switch and replace as necessary.

Problem	Possible Cause	Correction
	Defective Fuel shutoff relay.	Test relay and replace as necessary.
	Malfunctioning fuel shutoff solenoid.	Test fuel shutoff solenoid and replace as necessary.
	Defective operator safety module.	Test module and replace as necessary.
	Open wiring in safe operation circuit.	Check for loose connectors, grounds, and wiring damage.
Engine continues to run after operator has left seat for more than two seconds and mid PTO and park brake is not engaged	Defective seat safety switch.	Test seat safety switch and replace as necessary.
	Defective operator safety module.	Test operator safety module and replace as necessary.
	Malfunctioning fuel shutoff solenoid.	Test fuel shutoff solenoid and replace as necessary.
	Short-circuit in wiring or faulty ground circuit.	Check for loose safety switch connectors, grounds, and wiring harness for damage.

Wiring harness - Troubleshooting Safe operation - Operator not present, PTO "OFF"

Problem	Possible Cause	Correction
Engine does not continue to run while operator is seated	Defective neutral safety switch.	Test neutral safety switch and replace as necessary.
	Blown **3 A** diode.	Check diode, replace if necessary.
	Defective Fuel shutoff relay.	Test relay and replace as necessary
	Malfunctioning fuel shutoff solenoid.	Test fuel shutoff solenoid and replace as necessary.
	Defective operator safety module.	Test module and replace as necessary.
	Open wiring in safe operation circuit.	Check for loose connectors, grounds, and wiring damage.
Engine continues to run after operator has left seat for more than two seconds with transmission range in gear	Defective neutral safety switch.	Test neutral safety switch and replace as necessary.
	Defective operator safety module.	Test operator safety module and replace as necessary.
	Malfunctioning fuel shutoff solenoid.	Test fuel shutoff solenoid and replace as necessary.
	Short-circuit in wiring or faulty ground circuit.	Check for loose safety switch connectors, grounds, and wiring harness for damage.

Wiring harness - Troubleshooting Safe operation - Operator not present; PTO “ON”

Problem	Possible Cause	Correction
Engine does not continue to run while operator is not seated	Defective fuel shutoff relay.	Test relay and replace as necessary.
	Blown **3 A** diode.	Check diode, replace if necessary.
	Malfunctioning fuel shutoff solenoid.	Test fuel shutoff solenoid and replace as necessary.
	Defective operator safety module.	Test module and replace as necessary.

Problem	Possible Cause	Correction
	Open wiring in safe operation circuit.	Check for loose connectors, grounds, and wiring damage.
Engine does not continue to run when operator is not in seat, transmission is in neutral, PTO is on, and park brake is engaged	Defective range neutral switch, PTO switch, or **3 A** diode.	Test components and replace as necessary.

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LIGHTING SYSTEM - 40.A

Workmaster 45
Workmaster 55

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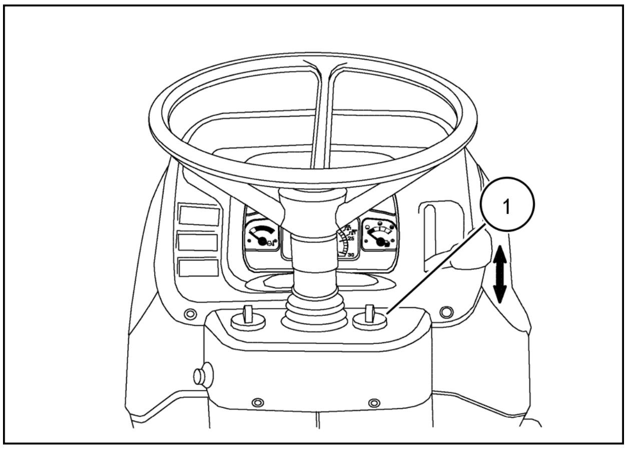
LIGHTING SYSTEM - Static description Light switch

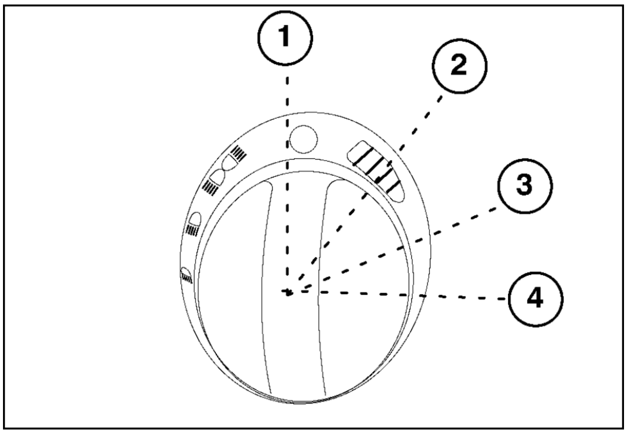
The light switch, **(1)**, is located on the right side of the dash panel.



56072028 1

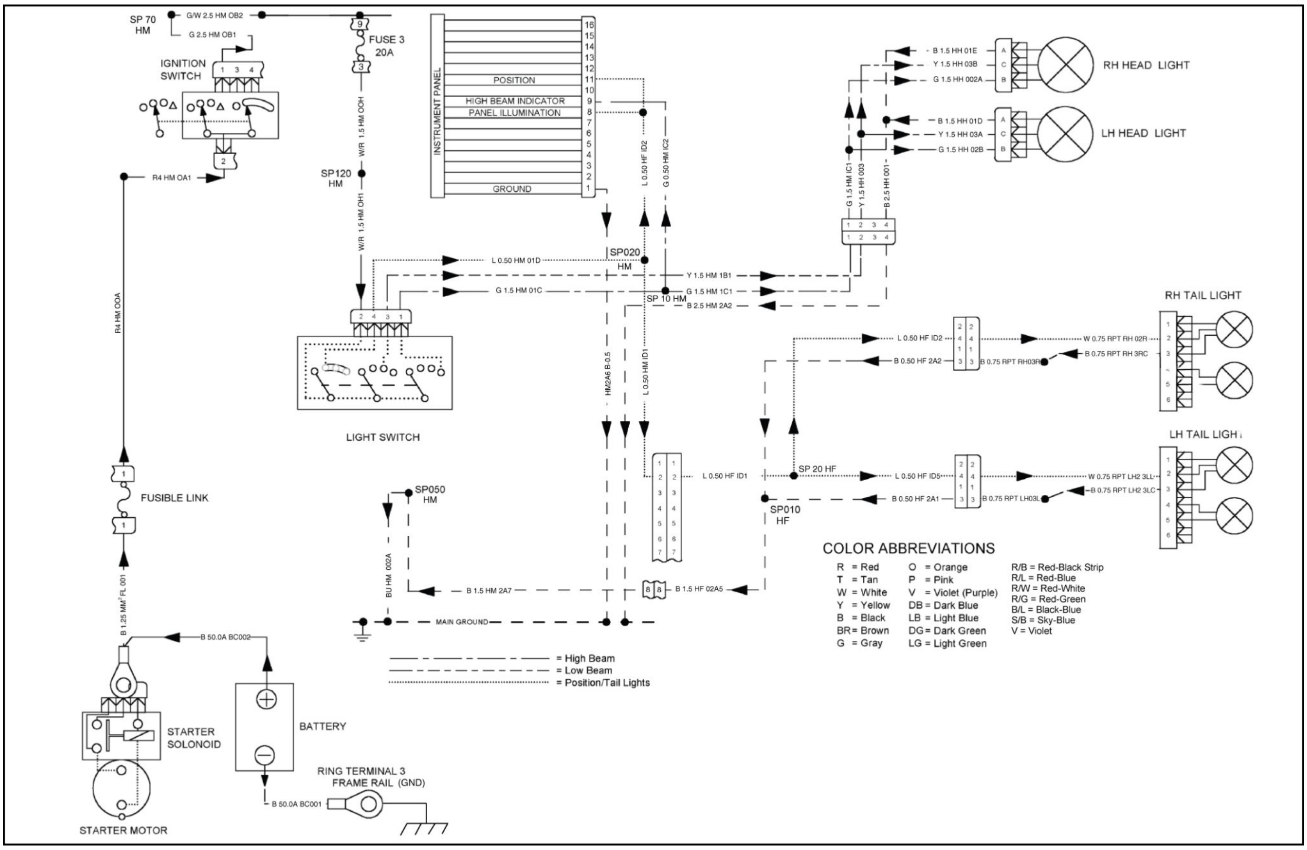
This is a rotary type switch that has four positions: (rotating clockwise from "OFF" position).

1. Off **(1)**.
2. Instrument panel and Taillights **(2)**.
3. Low beam, Instrument panel and Taillights **(3)**.
4. High beam, Instrument panel and Taillights **(4)** (A blue high beam indicator light will illuminate in the instrument panel when the road lights are illuminated).



20097560 2

LIGHTING SYSTEM - Static description Lighting circuit



20103308 1

1. Current starts at the battery, and flows through the positive (+) battery cable to the engine starter motor.
2. From the starter motor, current flows through the fusible link to the #2 terminal of the ignition switch.
3. When the ignition switch is placed in the "RUN" position current is transferred across the following ignition switch terminals:

- #2 to #1 terminals

Terminal #4 of Ignition Switch

1. Current flows from the #4 terminal of the ignition switch to the fuse panel bussbar, from the bussbar current travels through the fuse head/park, **20 A** fuse.

Fuse Functions

1. The fuse head/park, **20 A** fuse, sends current to the #2 terminal of the light switch.

Light Switch Functions

- OFF
- 1st position
  Instrument panel illumination
  Taillights
  Position light indicator light in instrument panel
- 2nd position
  Instrument panel illumination
  Taillights
  Position light indicator light in instrument panel
  Headlights low beam

- 3rd position
  Instrument panel illumination
  Taillights
  Position light indicator light in instrument panel
  Headlights High beam
  Headlights High beam indicator light in instrument panel

1st Position / Taillights

1. When the light switch is place in the first position current is transferred from terminal #2 to terminal #4 of the switch.
2. Terminal #4 supplies current to:
   - Instrument panel illumination terminal #8 of instrument panel
   - Position lights indicator light in instrument panel, terminal #11
   - Right and Left taillights

2nd Position Headlights Low Beam

1. When the light switch is place in the second position current is transferred from terminal #2 to terminal #4 and #3 of the switch.
2. Terminal #4 supplies current to:
   - Instrument panel illumination terminal #8 of instrument panel
   - Position lights indicator light in instrument panel, terminal #11
   - Right and Left taillights
3. Terminal #3 supplies current to :
   - Right and Left Headlight (low beam)

3rd Position Headlights High Beam

1. When the light switch is place in the third position current is transferred from terminal #2 to terminal #4, #3 and #1 of the switch.
2. Terminal #4 supplies current to:
   - Instrument panel illumination terminal #8 of instrument panel
   - Position lights indicator light in instrument panel, terminal #11
   - Right and Left taillights
3. Terminal #3 supplies current to :
   - Right and Left Headlight (low beam)
4. Terminal #1 supplies current to:
   - Right and Left Headlight (high beam)
   - High beam indicator light in instrument panel, terminal #9

NOTE: *Headlight bulbs are a dual filament **35 W / 35 W** bulb, when headlights are on high beam both elements are illuminated.*

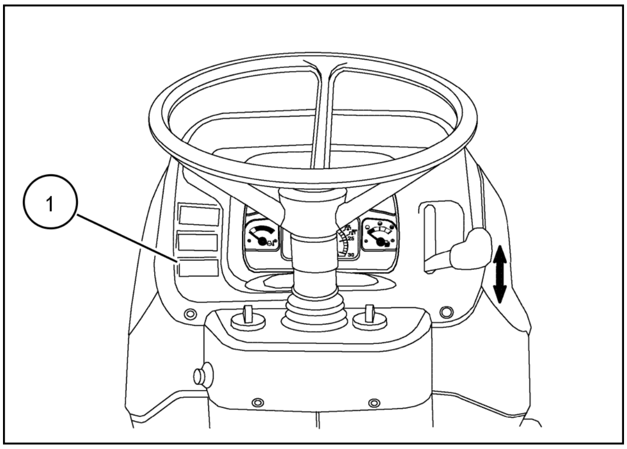
Turn/hazard light - Static description Hazard light switch

The hazard light switch, **(1)**, is a rocker-type switch located on the left-hand side of the dash. The two positions of the hazard light switch are:

- OFF (safety symbol protruding out of switch)
- ON (safety symbol pushed into switch)

When the hazard light switch is in the "ON" position, the safety symbol (on Hazard switch knob) will illuminate red and flash amber lamps.

NOTE: *The hazard lights can be activated with the key switch in the "OFF" position.*



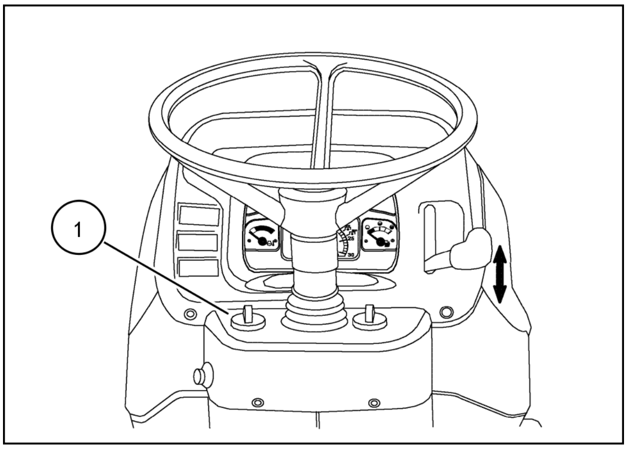
56072028 1

Turn/hazard light - Static description Turn light switch

The turn signal switch, **(1)**, is located on the left side panel. The turn signal switch has three positions; OFF (Center), LEFT and RIGHT. Moving the switch from the OFF position aligns the electrical contacts within the switch. With the contacts aligned, the circuit is closed and battery current will flow through the circuit.

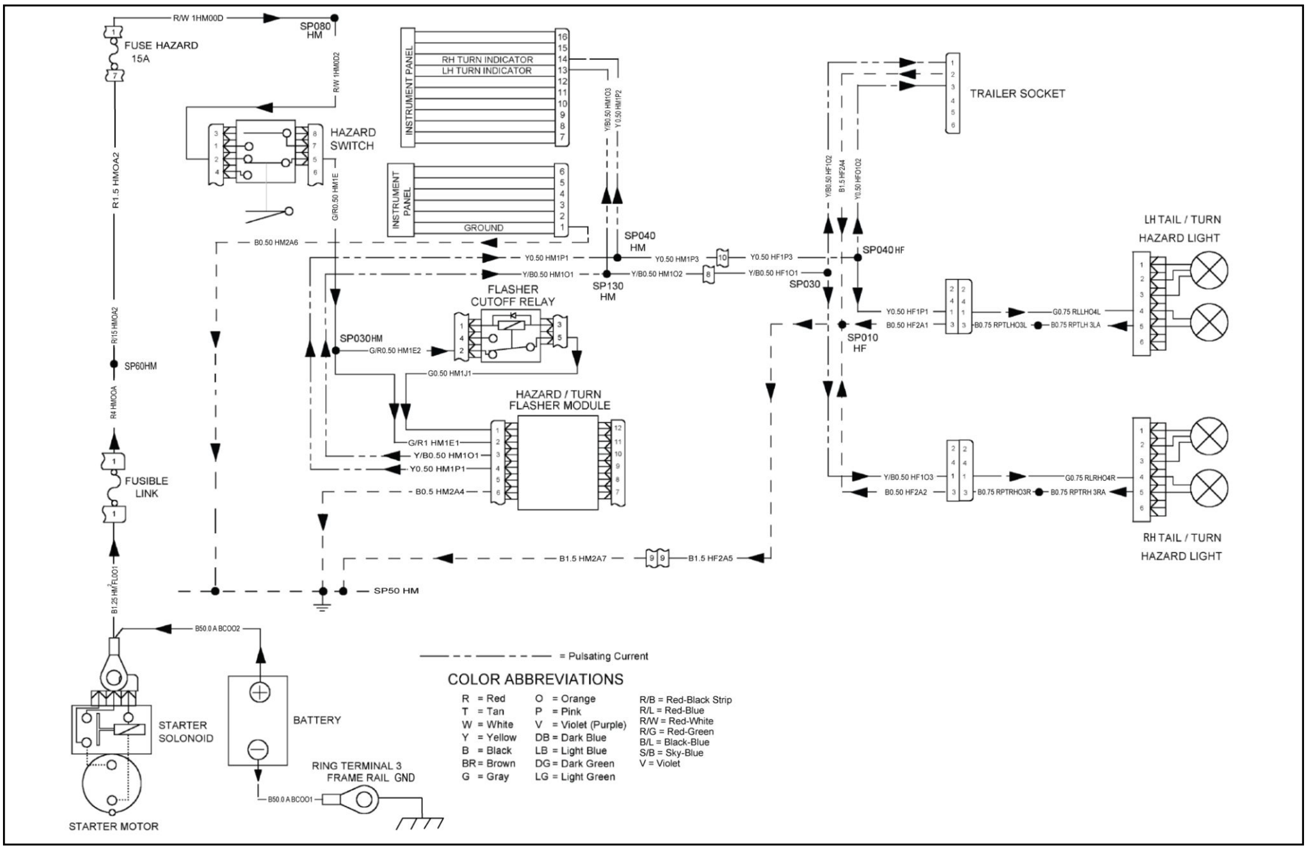
Refer to the following chart for description of the turn signal switch operation.

Turn signal switch position	Result
LEFT	The left flasher (amber) and the left taillight (red) pulse. The right flasher and taillight remain lit.
RIGHT	The right flasher (amber) and the right taillight (red) pulse. The left flasher and taillight remain lit.



56072028 1

Turn/hazard light - Static description Hazard lighting circuit



20103309 1

1. Current starts at the battery, and flows through the positive (+) battery cable to the engine starter motor.
2. From the starter motor, current flows through the fusible link to the #1, **15 A** fuse.

Fuse Functions

1. The #1, **15 A** fuse, sends current to the #2 terminal of the hazard light switch.

Hazard Light Switch

1. When the hazard light switch is place in the "ON" position, terminals #2 and #5 are connected.
2. Terminal #5 sends current in two directions:
   - Terminal #2 of the flasher cutoff relay
   - Terminal #2 of the hazard/turn flasher module

Flasher Cutoff Relay

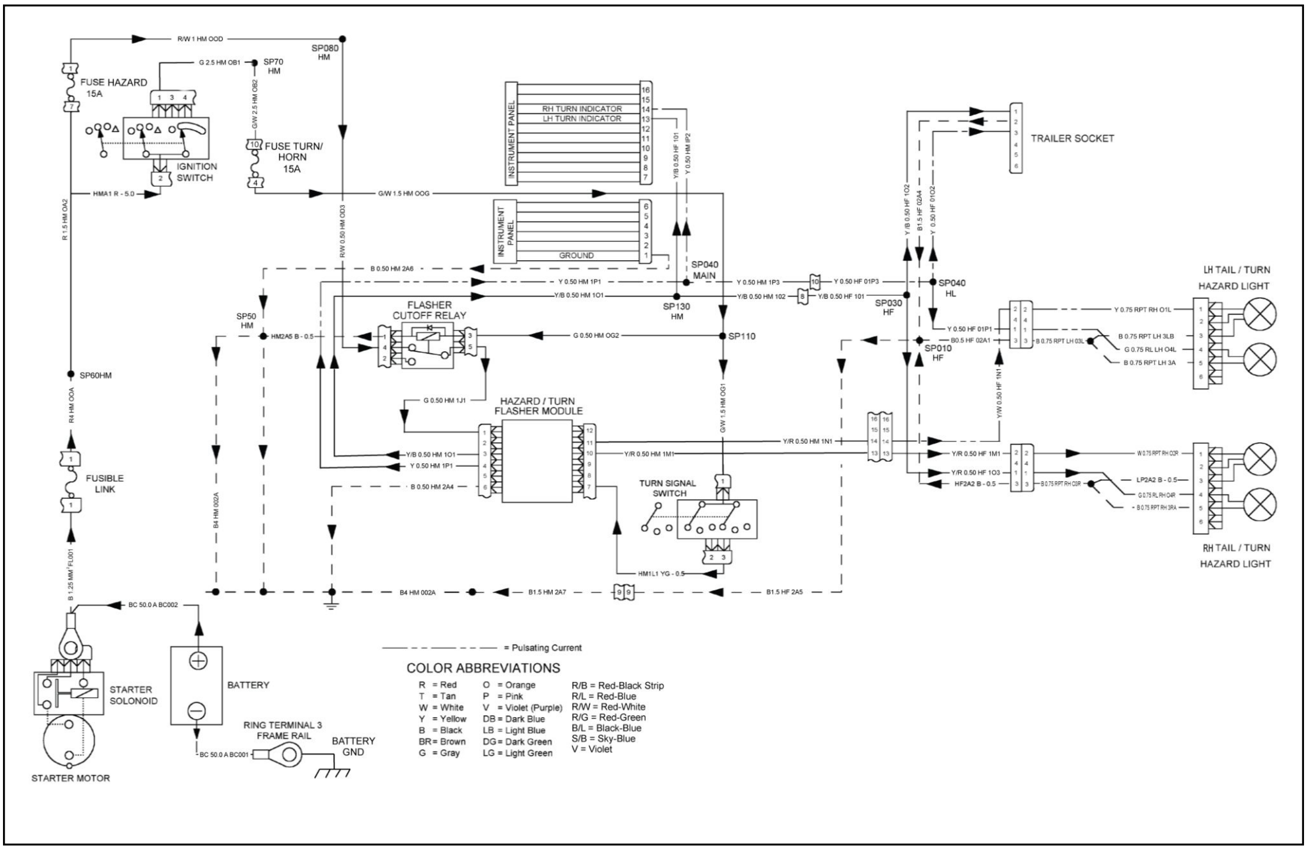
1. The flasher cutoff relay is not energized, when not energized terminals #2 and #5 are connected.
2. Terminal #5 of the flasher cutoff relay sends current to terminal #1 of the hazard/turn flasher module.

Hazard/Turn Flasher Module

1. When terminals #1 and #2 are supplied with current and terminal #6 has a ground source supplied, the following terminals send out pulsating current:
   - Terminal #3 (Left hazard light circuit)
   - Terminal #4 (Right hazard light circuit)
2. Terminal #3 supplies pulsating current to the left hazard light, terminal #13 of the instrument panel and terminal #1 of the trailer socket.

3. Terminal #4 supplies pulsating current to the right hazard light, terminal #14 of the instrument panel and terminal #3 of the trailer socket.
4. With ground source supplied to hazard lights and instrument panel, the hazard lights and instrument panel indicator lights flash on and off.

Turn/hazard light - Static description Right turn signal circuit



20103306 1

1. Current starts at the battery, and flows through the positive (+) battery cable to the engine starter motor.
2. From the starter motor, current flows through the fusible link to the #2 terminal of the ignition switch.
3. When the ignition switch is placed in the "RUN" position current is transferred across the following ignition switch terminals:
    - #2 to #1 terminals

Terminal #1 of Ignition Switch

1. Current flows from the #1 terminal of the ignition switch to the fuse panel bussbar, from the bussbar current travels through the #1, **15 A** fuse (Hazard).

Fuse Functions

1. The fuse hazard, **15 A** fuse, sends current to the #4 terminal of the flasher cutoff relay.
2. The fuse turn/horn, **15 A** fuse, sends current to the #1 terminal of the turn signal switch and terminal #3 of the flasher cutoff relay.

Flasher Cutoff Relay

1. The flasher cutoff relay is energized, allowing terminals #4 and #5 to be connected.
2. Terminal #5 of the flasher cutoff relay sends current to terminal #1 of the hazard/turn flasher module.

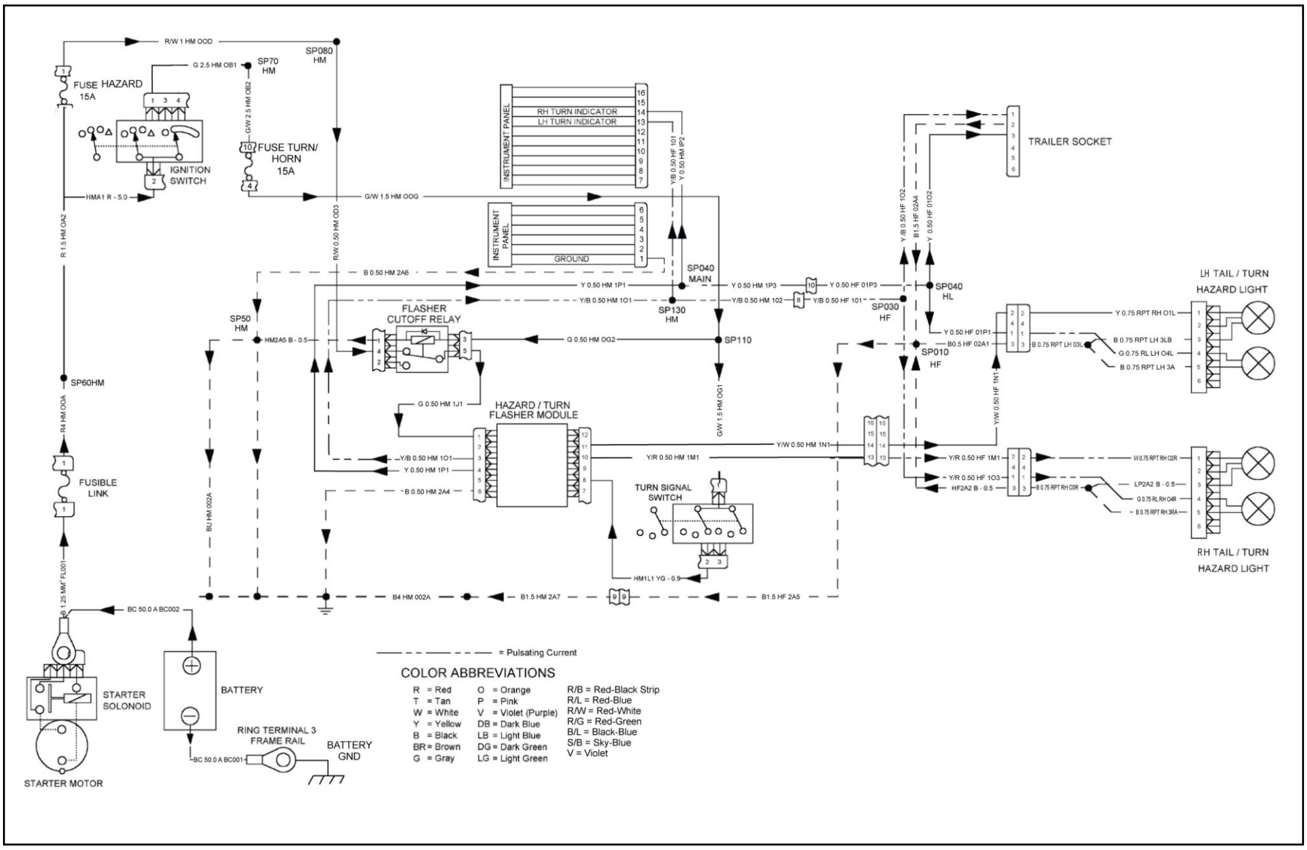
Turn Signal Switch

1. 1. When the turn signal is placed in the right turn position, terminals #1 and #3 are connected.
2. Terminal #3 of the turn signal switch sends current to terminal #7 of the hazard/turn flasher module.

Hazard/Turn Flasher Module

1. When terminals #1 and #7 are supplied with current and terminal #6 has a ground source supplied, the following terminals functions are:
    - Terminal #3 left taillight continuous illumination
    - Terminal #4 right taillight pulsating illumination
    - Terminal #10 left hazard light continuous illumination
    - Terminal #11 right hazard light pulsating illumination
2. Terminal #3 supplies continuous current to terminal #13 of the instrument panel, left taillight and terminal #1 of the trailer socket.
3. Terminal #4 supplies pulsating current to the terminal #14 of the instrument panel, right taillight and terminal #3 of the trailer socket.
4. With ground source supplied to hazard light, taillight and instrument panel, the right side hazard light, taillight and instrument panel indicator lights flash on and off.
5. With ground source supplied to hazard light, taillight and instrument panel, the left side hazard light, taillight and instrument panel indicator lights continuously illuminate.

Turn/hazard light - Static description Left turn signal circuit



20103307 1

1. Current starts at the battery, and flows through the positive (+) battery cable to the engine starter motor.
2. From the starter motor, current flows through the fusible link to the #2 terminal of the ignition switch.
3. When the ignition switch is placed in the "RUN" position current is transferred across the following ignition switch terminals:
   - #2 to #1 terminals

Terminal #1 of Ignition Switch

1. Current flows from the #1 terminal of the ignition switch to the fuse panel bussbar, from the bussbar current travels through the #1, **15 A** fuse (Hazard).

Fuse Functions

1. The fuse hazard, **15 A** fuse, sends current to the #4 terminal of the flasher cutoff relay.
2. The fuse turn/horn, **15 A** fuse, sends current to the #1 terminal of the turn signal switch and terminal #3 of the flasher cutoff relay.

Flasher Cutoff Relay

1. The flasher cutoff relay is energized, allowing terminals #4 and #5 to be connected.
2. Terminal #5 of the flasher cutoff relay sends current to terminal #1 of the hazard//turn flasher module.

Turn Signal Switch

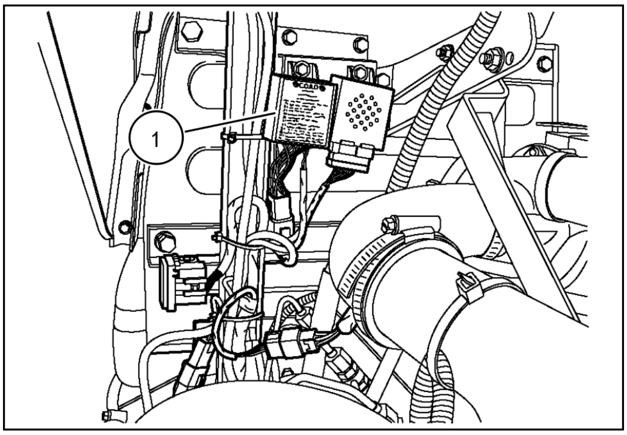
1. When the turn signal is placed in the left turn position, terminals #1 and #2 are connected.
2. Terminal #2 of the turn signal switch sends current to terminal #8 of the hazard/turn flasher module.

Hazard/Turn Flasher Module

1. When terminals #1 and #8 are supplied with current and terminal #6 has a ground source supplied, the following terminals functions are:
    - Terminal #3 left taillight pulsating illumination
    - Terminal #4 right taillight continuous illumination
    - Terminal #10 left hazard light pulsating illumination
    - Terminal #11 right hazard light continuous illumination
2. Terminal #3 supplies pulsating current to terminal #13 of the instrument panel, left taillight and terminal #1 of the trailer socket.
3. Terminal #4 supplies continuous current to the terminal #14 of the instrument panel, right taillight and terminal #3 of the trailer socket.
4. With ground source supplied to hazard light, taillight and instrument panel, the left side hazard light, taillight and instrument panel indicator lights flash on and off.
5. With ground source supplied to hazard light, taillight and instrument panel, the right side hazard light, taillight and instrument panel indicator lights continuously illuminate.

Turn/hazard light - Static description Hazard flasher/Turn signal control module

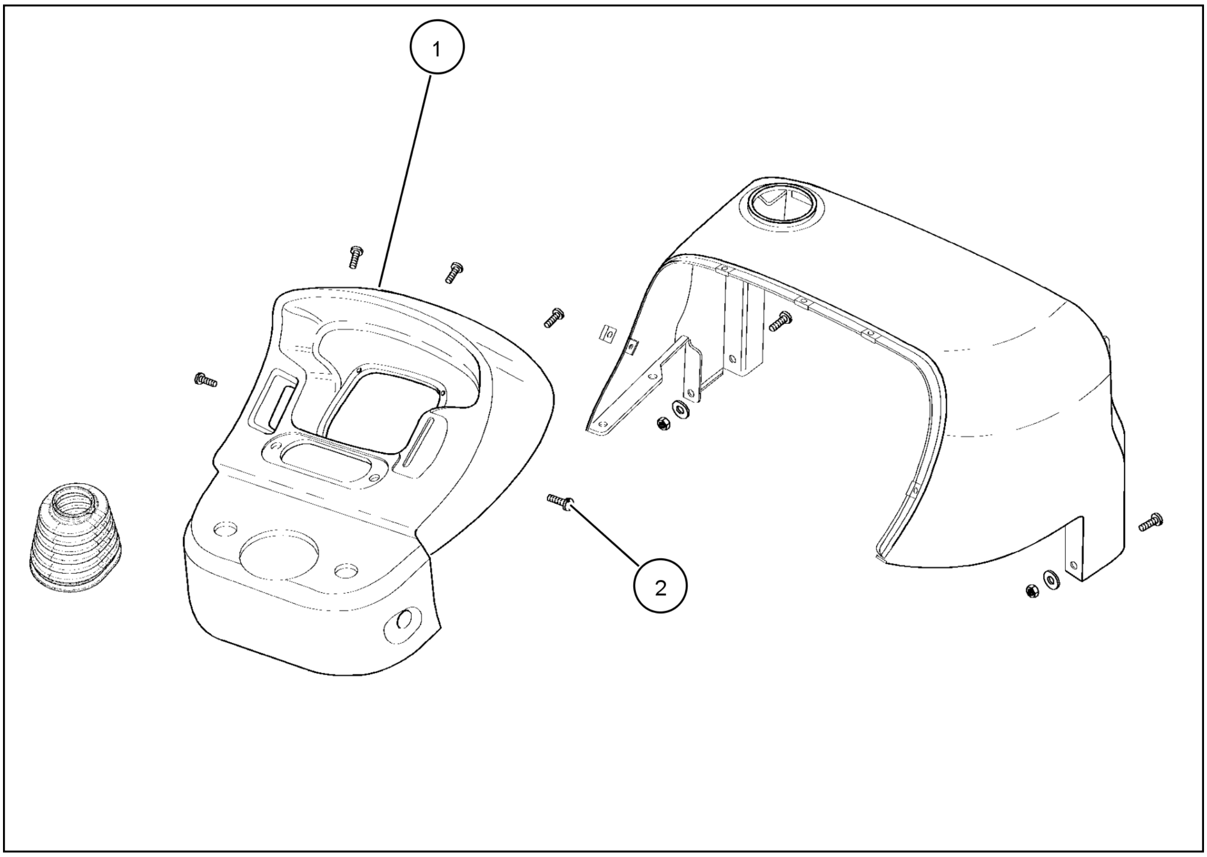
The hazard flasher/turn signal control module, **(1)**, is located right side of engine compartment. The control module controls current flowing to the hazard flasher/turn signal lights on the rear fenders. Refer to the chart below for the functions of the control module.



200900106 1

HAZARD/TURN SIGNAL SWITCH POSITION	RESULT
Hazard switch "On"	Both flashers blink in unison.
Left turn signal "On"	Left flasher and taillight blink and right flasher and taillight remain solid.
Right turn signal "On"	Right flasher and taillight blink and left flasher and taillight remain solid.

LIGHTING SYSTEM - Remove Light switch



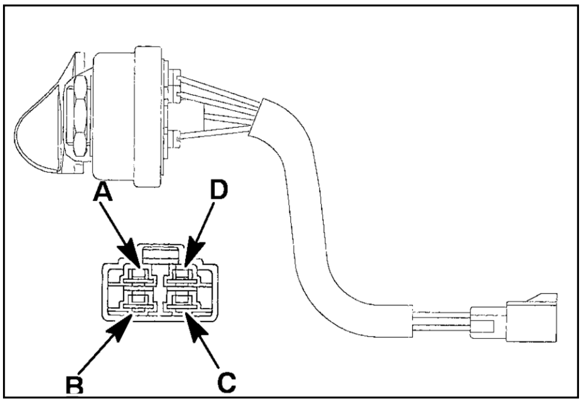
66064725 1

1. Disconnect the negative (-) battery cable from the negative (-) battery terminal.
2. Remove the top console panel, **(1)**, by removing the eight retaining screws, **(2)**. Disconnect the wire harness connector from the switch.
3. Insert a small punch into the access hole in the knob. Depress the pin in the switch shaft with the punch and pull the knob off the shaft.
4. Remove the nut from the switch and pull switch from the panel.

Next operation:
LIGHTING SYSTEM - Test Light switch (A.40.A)

LIGHTING SYSTEM - Test Light switch

Prior operation:
LIGHTING SYSTEM - Remove Light switch (A.40.A)



66064486 1

Terminal Identification

Terminal ID	Function	Wire Color
A	**12 V** Input from Fusible link	Red/White
B	Taillights	Red
C	Headlights (LOW)	Yellow
D	Headlights (HIGH)	Green

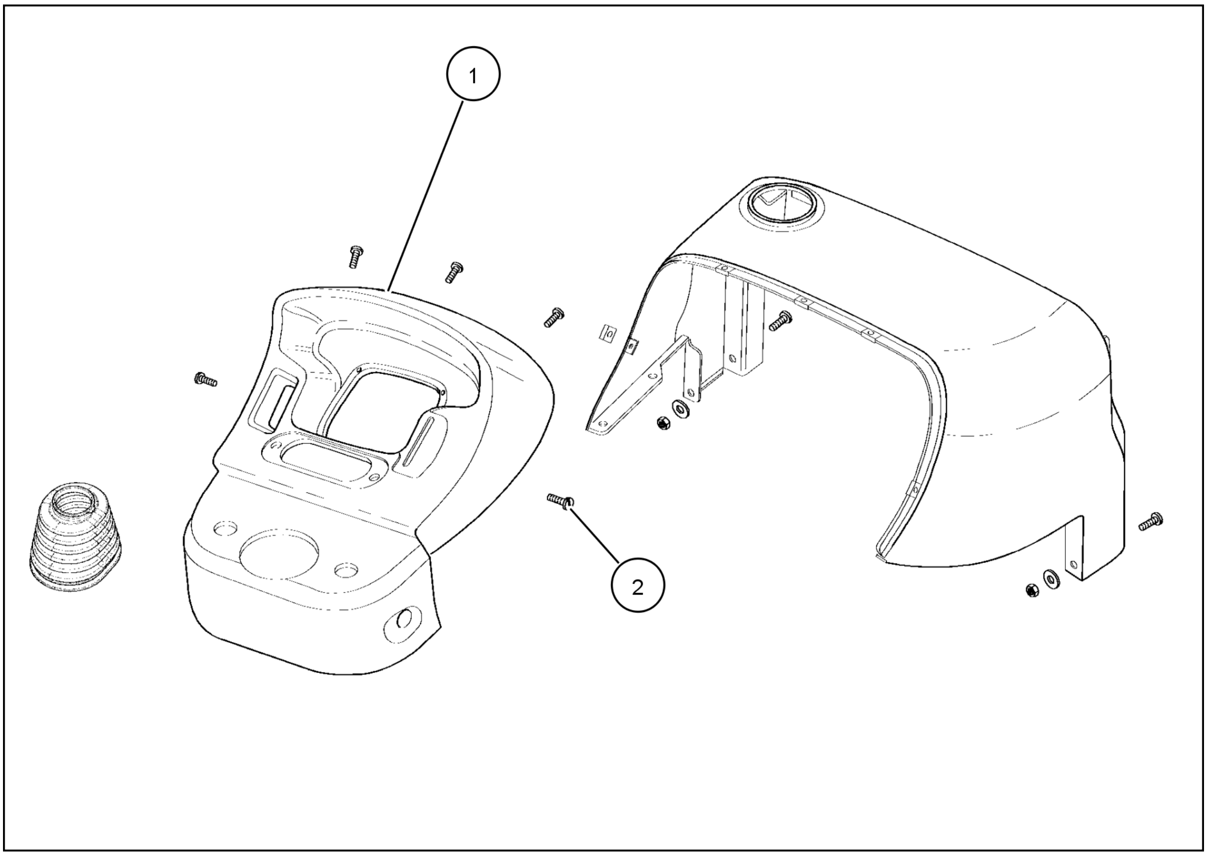
Testing

Position	Terminal Continuity
"OFF"	None
Taillights	A and B
Headlights (LOW)	A, B, and C
Headlights (HIGH)	A, B, C, and D

Next operation:
LIGHTING SYSTEM - Install Light switch (A.40.A)

LIGHTING SYSTEM - Install Light switch

Prior operation:
LIGHTING SYSTEM - Test Light switch (A.40.A)



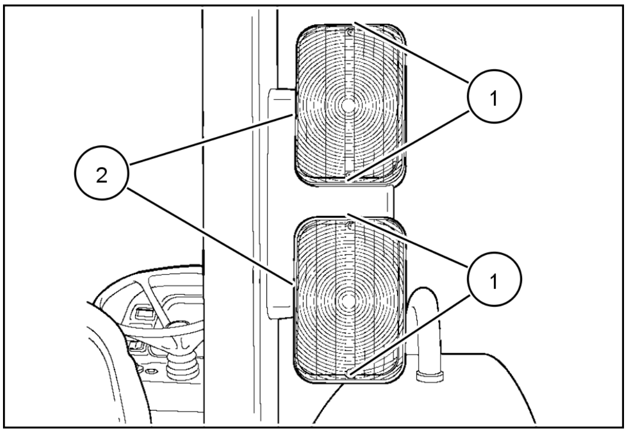
66064725 1

1. Insert the light switch into the back of the top panel so that the tabs on the switch align with the slots in the panel.
2. Install and tighten the retaining nut on the switch.
3. Using a small punch, push pin on switch shaft inward, while pushing knob onto the shaft.
4. Connect the main wiring harness to the switch.
5. Install the top console panel **(1)**, onto the tractor. Secure using the eight retaining screws, **(2)**.
6. Connect the negative (-) battery cable to the negative (-) battery terminal.

LIGHTING SYSTEM - Replace Bulb replacement

Turn/Position Lights/Flasher

The bulbs are accessible after removal of the plastic lens assembly. Remove the screws, **(1)**, and the lens, **(2)**, assembly. The bulbs have a conventional bayonet cap and can be removed by pressing in and turning approximately **20 °** counterclockwise. Reassemble in reverse order.



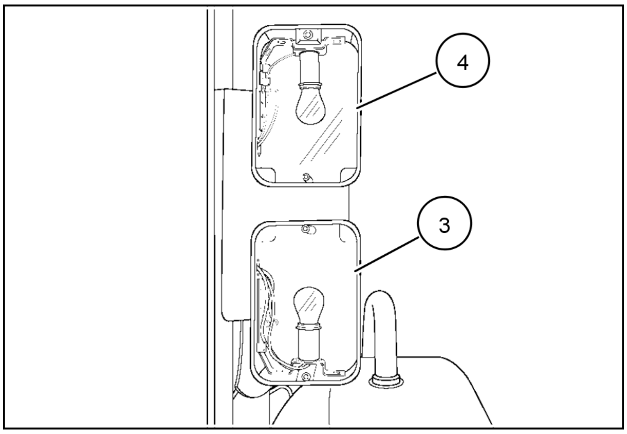
20097585 1

NOTE: *When replacing the lens, take care not to over tight the retaining screws.*

- Taillight, **(3)**.
- Flasher/Turn Signal, **(4)**.

Bulb Sizes

- Taillight #1157
- Flasher #1156

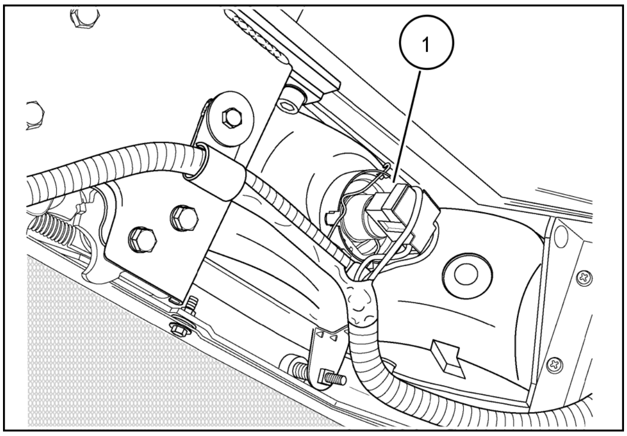


20097586 2

Head light - Replace Head lamp

If head lamps fail to operate, the bulb must be replaced. To change the bulb:

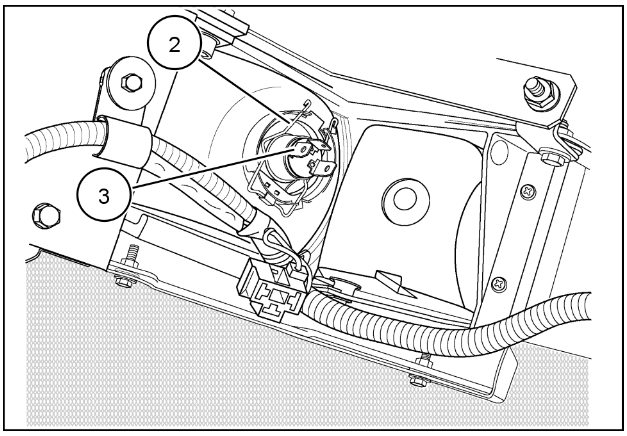
1. Open the tractor hood.
2. Bulb Removal:
   - Remove wire harness connector, **(1)**, from bulb. Compress retaining clip, **(2)**, and remove bulb, **(3)**, from the socket.
3. Bulb Replacement:
   - Insert bulb assembly and secure with retaining clips.



56072029 1

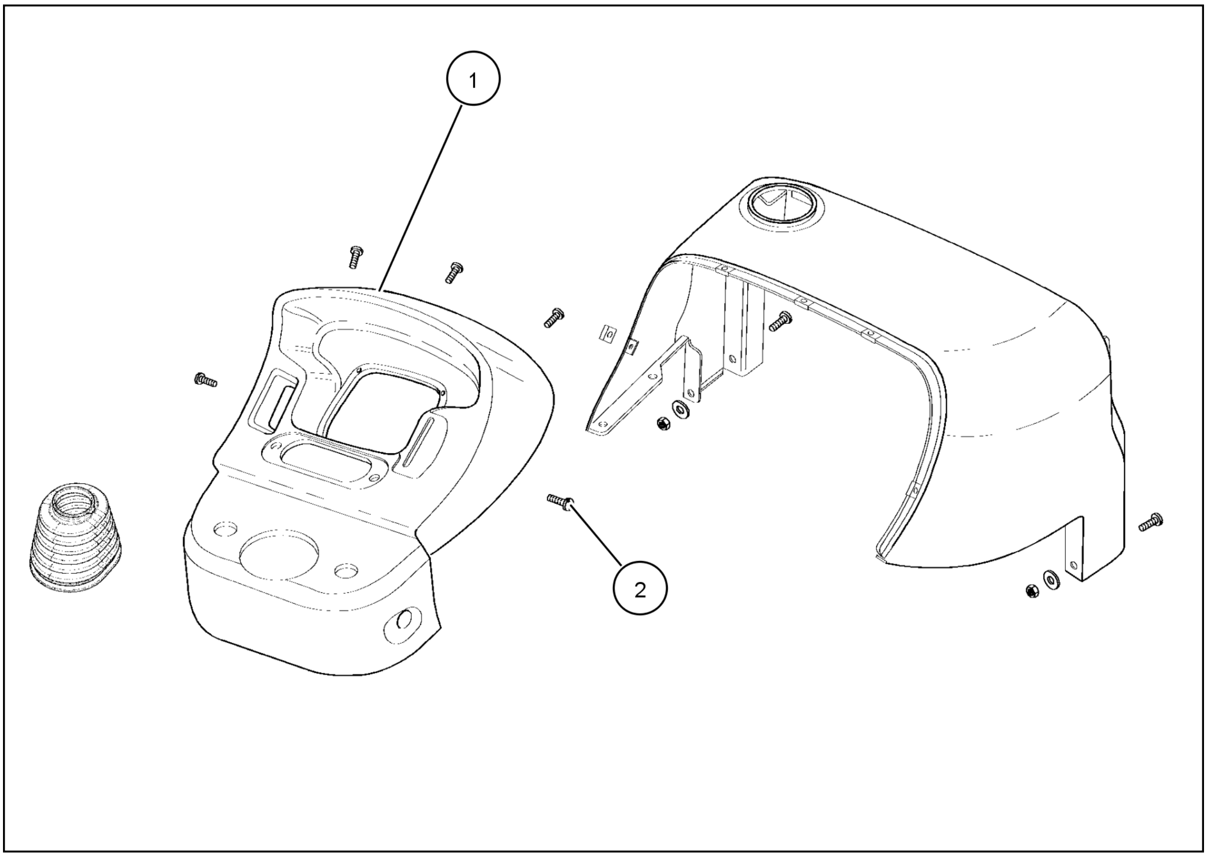
NOTE: *Be careful not to touch the bulb with bare fingers. Oil from the fingers can shorten the life of bulb. Use protective cloth or glove when installing bulb.*

NOTE: *Replacement bulbs are dual element* ***35 W/ 35 W****, halogen.*



56072030 2

Turn/hazard light - Remove Hazard light switch

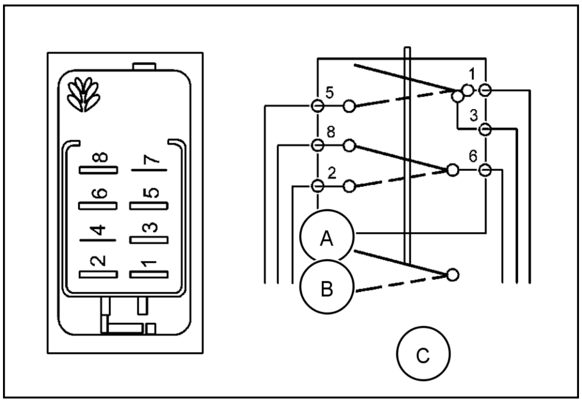


66064725 1

1. Disconnect the negative (-) battery cable from the negative (-) battery terminal.
2. Remove the top console panel, **(1)**, by removing the eight retaining screws, **(2)**. Disconnect the wire harness connector from the switch.
3. To remove the switch, release the retaining tabs and lift the switch out of the panel.

Next operation:
Turn/hazard light - Test Hazard light switch (A.40.A)

Turn/hazard light - Test Hazard light switch



66064487 1

A - OFF
B - ON
C - CIRCUIT DIAGRAM

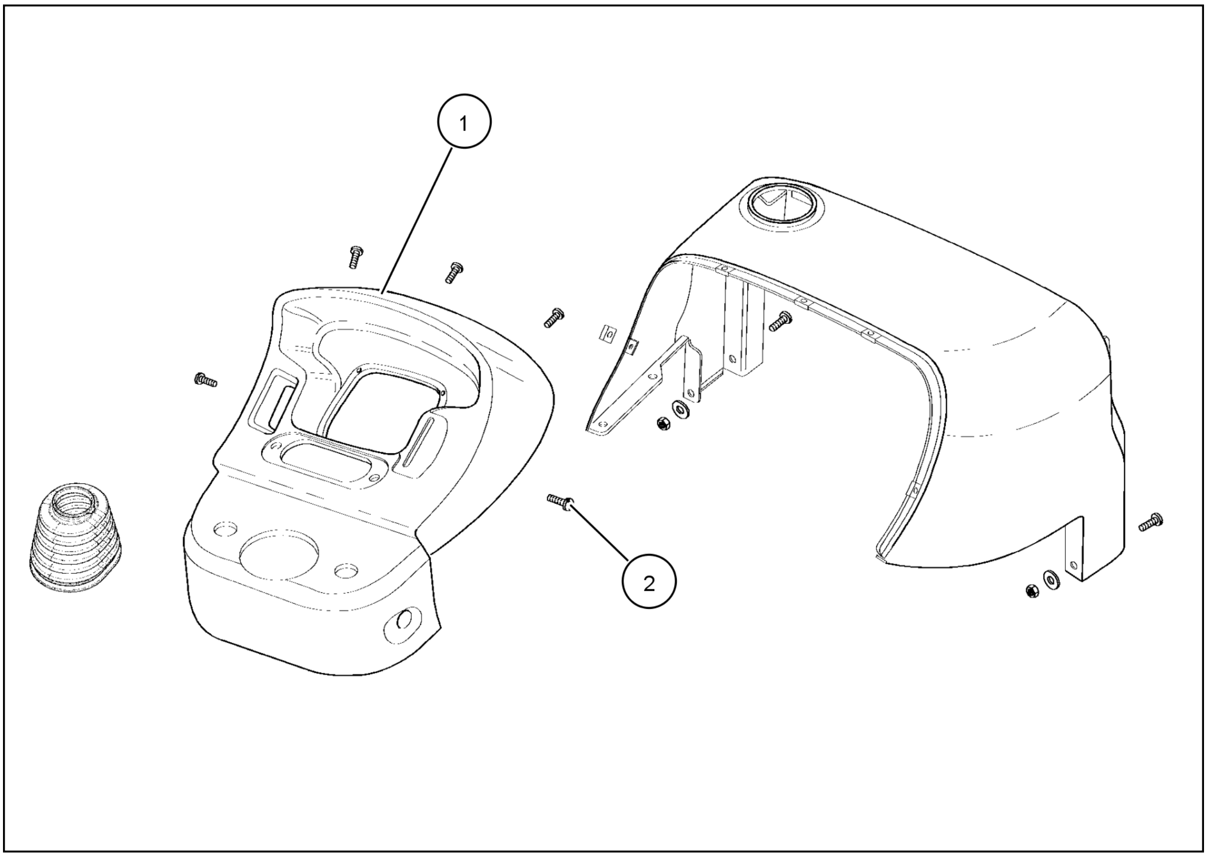
Terminal Identification

Terminal ID	Function	Wire Color
1	Not Used	XX
2	**12 V** Input from #3 Fuse	R/W 1 HM 0D2
3	Not Used	XX
4	No Terminal	XX
5	Not Used	XX
6	**12 V** Output to Hazard Module	G/R 1 HM 01E
7	No Terminal	XX
8	Not Used	XX

Testing

Position	Terminal Continuity
"OFF"	6 and 8
"ON"	1 and 5 2 and 6

Turn/hazard light - Install Hazard light switch

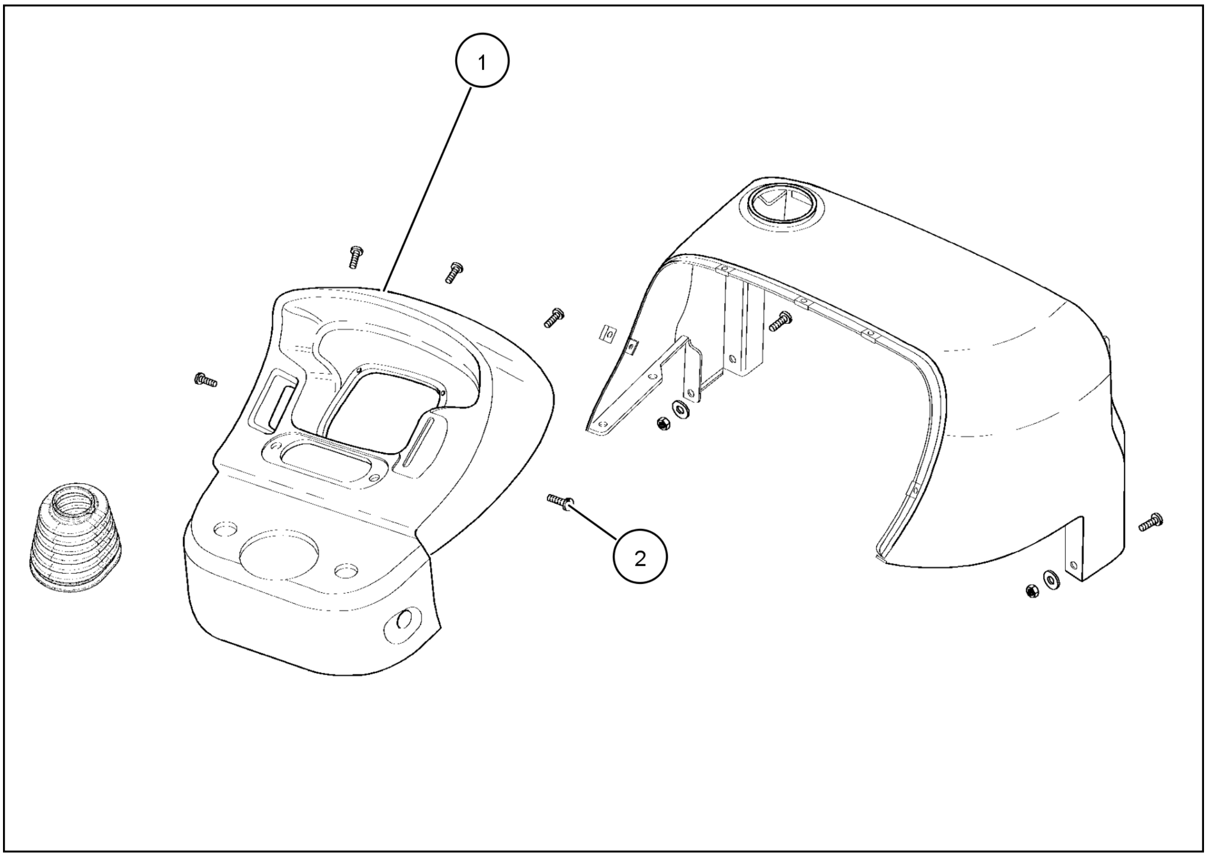


66064725 1

1. Insert the hazard light switch into the dash panel until the locking tabs click into place.
2. Connect the wiring harness to the hazard light switch.
3. Install the top console panel **(1)**, using the eight retaining screws, **(2)**.
4. Connect the negative (-) battery cable to the negative (-) battery terminal.
5. Lower the tractor engine cover.

Next operation:
Turn/hazard light - Test Hazard light switch (A.40.A)

Turn/hazard light - Remove Turn signal switch



66064725 1

1. Disconnect the negative (-) battery cable from the negative (-) battery terminal.
2. Remove the top console panel, **(1)**, by removing the eight retaining screws, **(2)**. Disconnect the wire harness connector from the switch.
3. Insert a small punch into the access slot in the knob. Depress the pin in the switch shaft with the punch and pull the knob off the shaft.
4. Remove the nut from the switch and pull switch from the panel.

Next operation:
Turn/hazard light - Test Turn signal switch (A.40.A)

Turn/hazard light - Test Turn signal switch

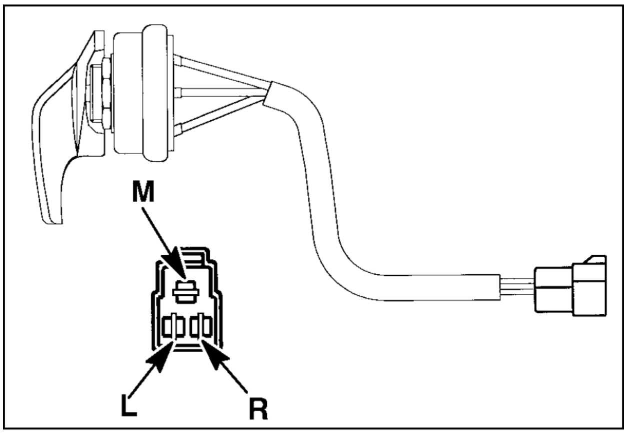
Prior operation:
Turn/hazard light - Remove Turn signal switch (A.40.A)

Terminal ID	Function	Wire Color
R	Left Turn	Yellow /Black
M	**12 V** Input from fuse turn/horn	Green
L	Right Turn	Yellow

Position	Terminal Continuity
"OFF"	None
"Left Turn"	M and R
"Right Turn"	M and L

Testing

Use an ohmmeter to test the three positions of the turn signal switch for electrical continuity.

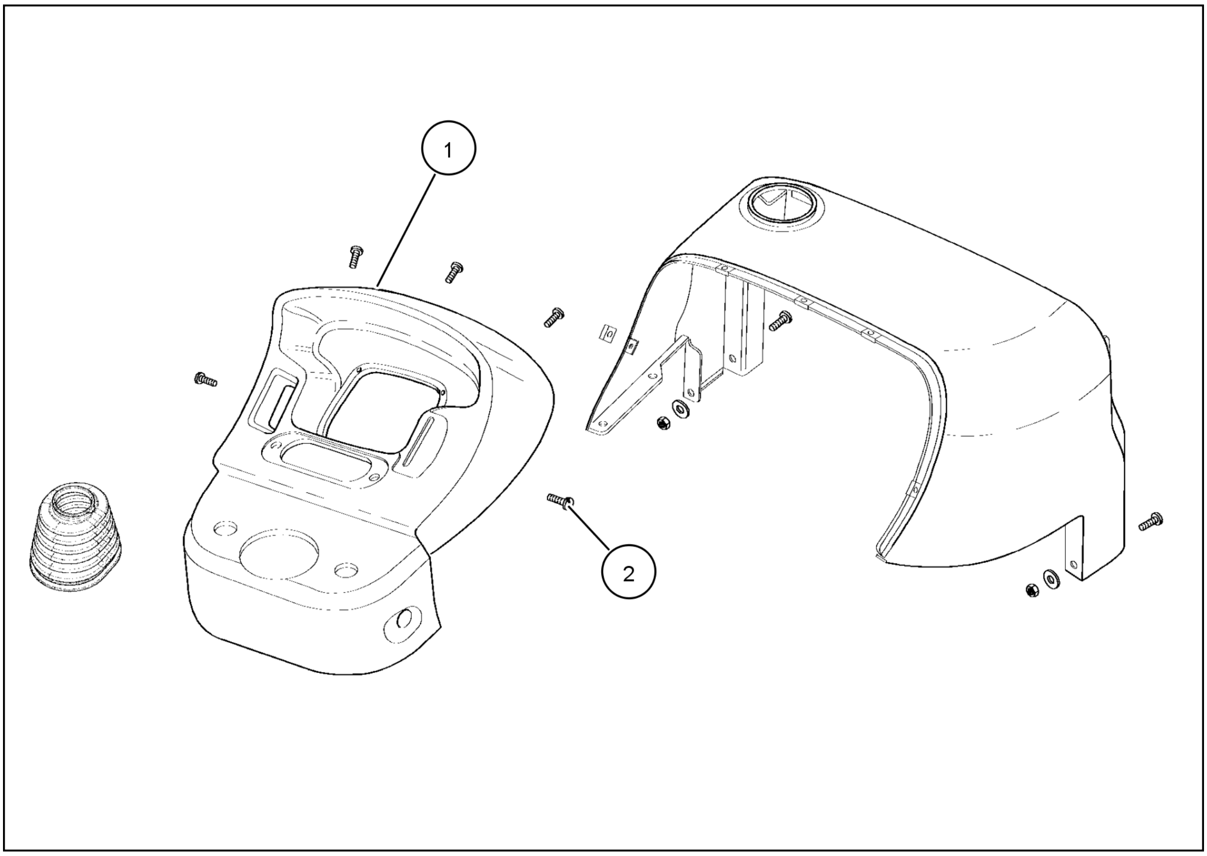


66064488 1

Next operation:
Turn/hazard light - Install Turn signal switch (A.40.A)

Turn/hazard light - Install Turn signal switch

Prior operation:
Turn/hazard light - Test Turn signal switch (A.40.A)

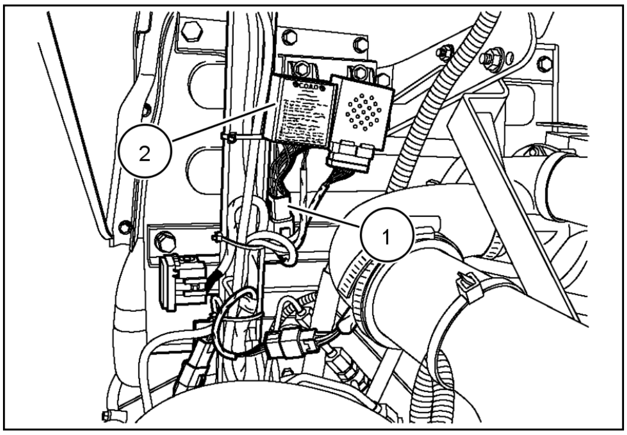


66064725 1

1. Insert the turn signal switch into the back of the top panel so that the tabs on the switch align with the slots in the panel.
2. Install and tighten the retaining nut on the switch.
3. Using a small punch, push pin on switch shaft inward, while pushing knob onto the shaft.
4. Connect the main wiring harness to the switch.
5. Install the top console panel **(1)**, onto the tractor. Secure using the eight retaining screws, **(2)**.
6. Connect the negative (-) battery cable to the negative (-) battery terminal.

Turn/hazard light - Remove Hazard flasher/Turn signal control module

1. Unplug the connector, **(1)**, from the control module, **(2)**.



200900106 1

Next operation:
Turn/hazard light - Test Hazard flasher/Turn signal control module (A.40.A)

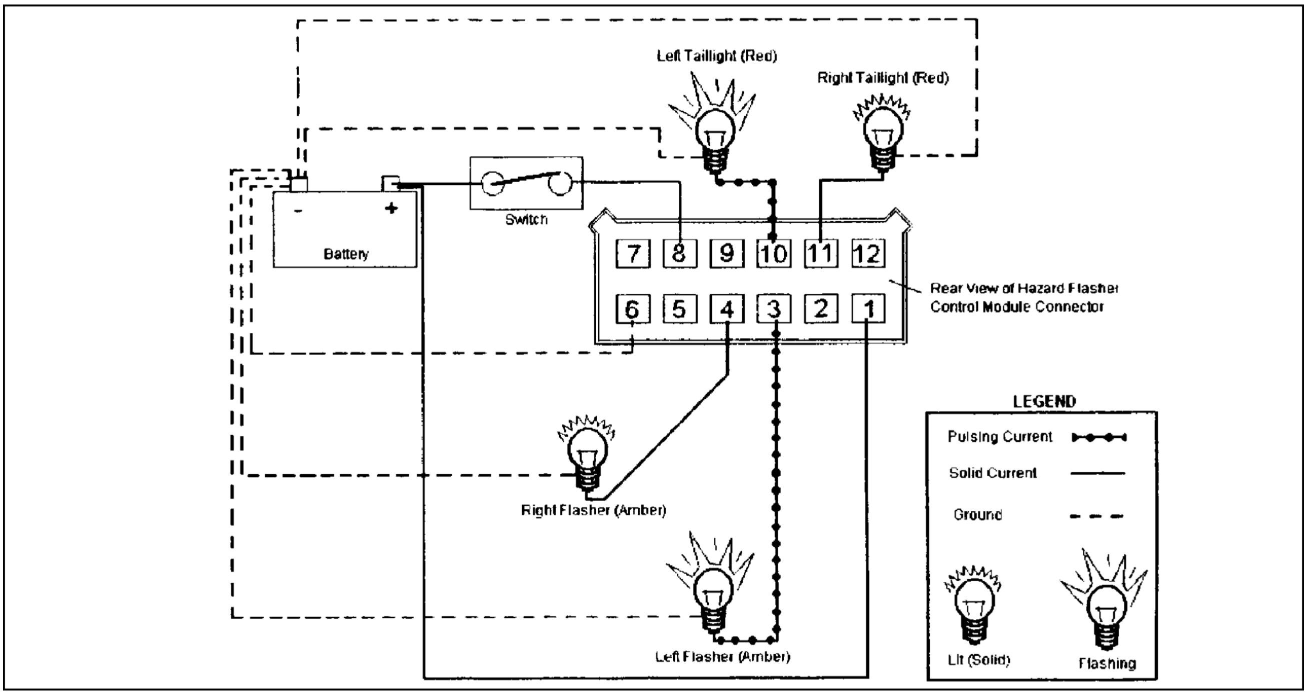
Turn/hazard light - Test Hazard flasher/Turn signal control module

Prior operation:
Turn/hazard light - Remove Hazard flasher/Turn signal control module (A.40.A)

Use a **12 V** power source, a suitable switch, jumper wires and test lights to perform the 3 tests on the hazard flasher /turn signal control module.

NOTE: *Disregard terminal markings on the module. Refer to terminal markings in the illustration.*

Test 1

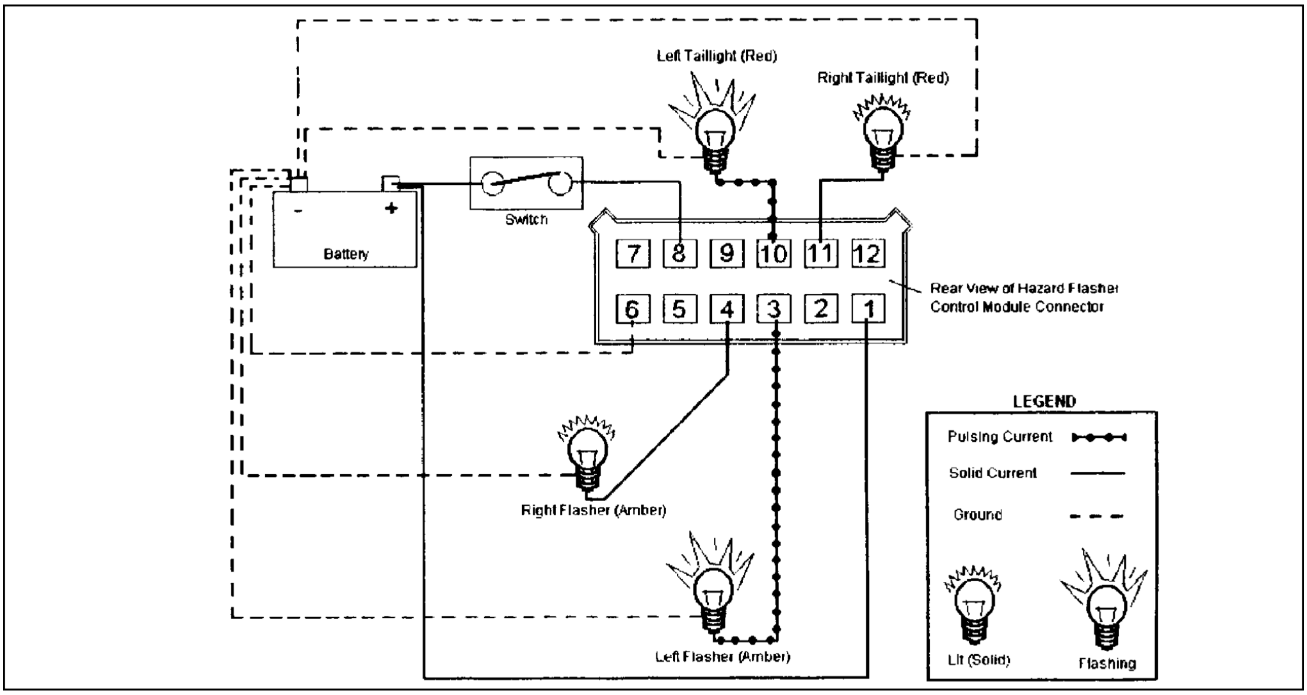


20023431 1

Test 1 is used to verify that the control module is supplying power to both of the hazard lights. This test simulates the hazard switch being turned to the "On" position.

1. Connect a jumper wire to terminal 3 of the control module and to the positive (+) terminal of a test light. This test light will simulate the left flasher. Connect the negative (-) terminal of test light to the negative (-) terminal of the power source.
2. Connect a jumper wire to terminal 4 of the control module and to the positive (+) terminal of a test light. This test light will simulate the right flasher. Connect the negative (-) terminal of the test light to the negative (-) terminal of the power source.
3. Connect a jumper wire to the positive (+) terminal of the power source and the switch.
4. Connect a jumper wire to the switch and terminal 2 on the control module.
5. Connect a jumper wire to the positive (+) terminal of the power source and to terminal 1 of the control module.
6. Connect a jumper wire to the negative (-) terminal of the power source and to terminal 6 of the control module.
7. Move the switch to the "On position, observe the two test lights. Both should flash on and off simultaneously.

Test 2

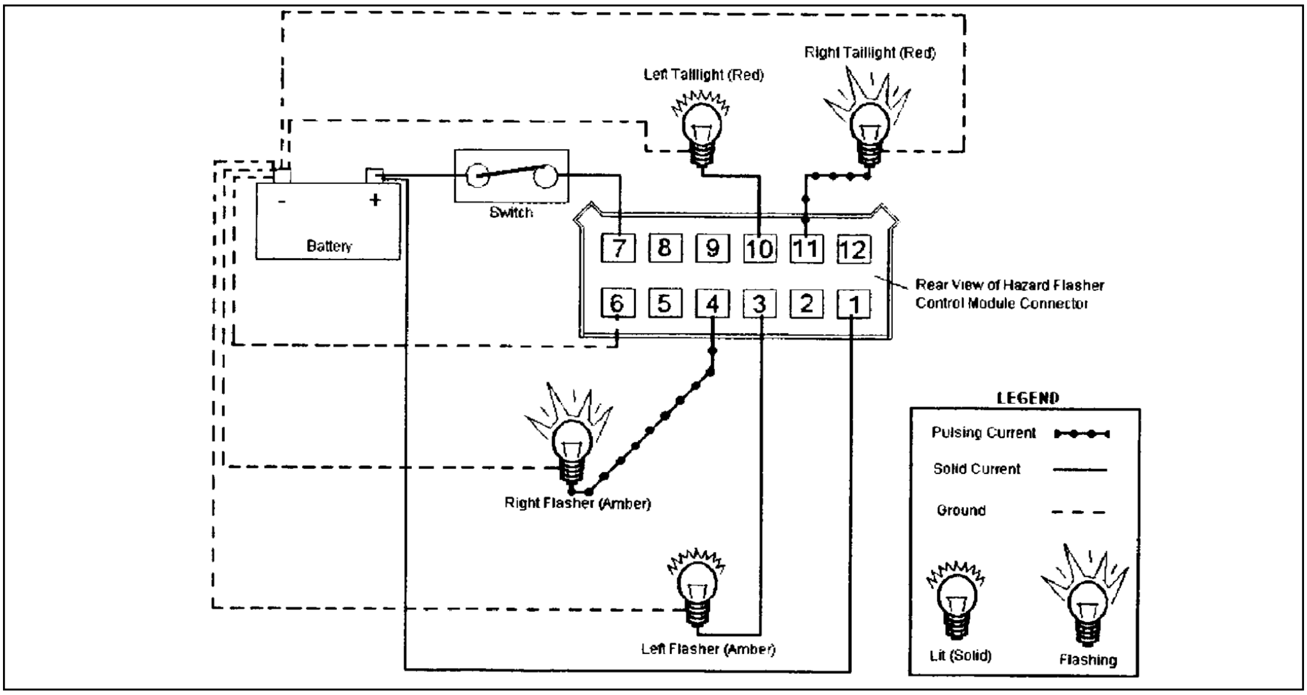


20023431 2

Test 2 is used to verify that the control module is functioning properly when the left turn signal is activated. This test simulates the turn signal switch being turned to the "Left" position.

1. Connect a jumper wire to terminal 10 of the control module and to the positive (+) terminal of a test light. This test light will simulate the left taillight (red). Connect a jumper wire to the (-) negative terminal of the test light and to the negative (-) terminal of the power source.
2. Connect a jumper wire to terminal 11 of the control module and to the positive (+) terminal of a test light. This test light will simulate the right taillight (red). Connect a jumper wire to the (-) negative terminal of the test light and to the negative (-) terminal of the power source.
3. Connect a jumper wire to terminal 4 of the control module and to the positive (+) terminal of a test light. This test light will simulate the right flasher (amber). Connect a jumper wire to the (-) negative terminal of the test light and to the negative (-) terminal of the power source.
4. Connect a jumper wire to terminal 3 of the control module and to the positive (+) terminal of a test light. This test light will simulate the left flasher (amber). Connect a jumper wire to the (-) negative terminal of the test light and to the negative (-) terminal of the power source.
5. Connect a jumper wire to the positive (+) terminal of the power source and the switch.
6. Connect a jumper wire to the switch and terminal 8 on the control module.
7. Connect a jumper wire to the positive (+) terminal of the power source and to terminal 1 of the control module.
8. Connect a jumper wire to the negative (-) terminal of the power source and to terminal 6 of the control module.
9. Switch the switch to the "On" position, observe the two test lights. The left flasher and the left taillight should both flash on and off while the right flasher and right taillight remain lit (solid).

Test 3



20023432 3

Test 3 is used to verify that the control module is functioning properly when the right turn signal is activated. This test simulates the turn signal switch being turned to the "Right" position.

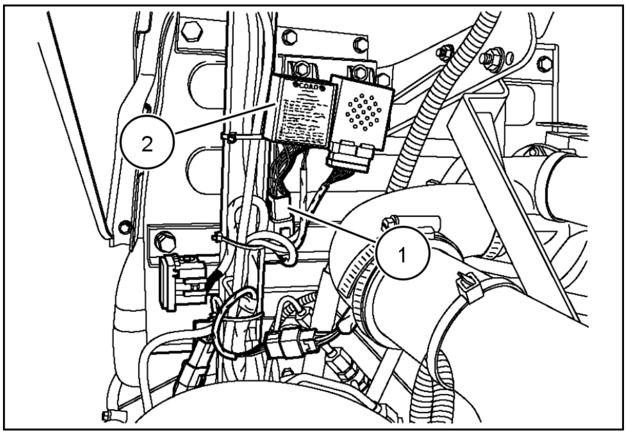
1. Connect a jumper wire to terminal 10 of the control module and to the positive (+) terminal of a test light. This test light will simulate the left taillight (red). Connect a jumper wire to the (-) negative terminal of the test light and to the negative (-) terminal of the power source.
2. Connect a jumper wire to terminal 11 of the control module and to the positive (+) terminal of a test light. This test light will simulate the right taillight (red). Connect a jumper wire to the (-) negative terminal of the test light and to the negative (-) terminal of the power source.
3. Connect a jumper wire to terminal 4 of the control module and to the positive (+) terminal of a test light. This test light will simulate the right flasher (amber). Connect a jumper wire to the (-) negative terminal of the test light and to the negative (-) terminal of the power source.
4. Connect a jumper wire to terminal 3 of the control module and to the positive (+) terminal of a test light. This test light will simulate the left flasher (amber). Connect a jumper wire to the (-) negative terminal of the test light and to the negative (-) terminal of the power source.
5. Connect a jumper wire to the positive (+) terminal of the power source and the switch.
6. Connect a jumper wire to the switch and terminal 7 on the control module.
7. Connect a jumper wire to the positive (+) terminal of the power source and to terminal 1 of the control module.
8. Connect a jumper wire to the negative (-) terminal of the power source and to terminal 6 of the control module.
9. Switch the switch to the "On" position, observe the two test lights. The right flasher and the right taillight should both flash on and off while the left flasher and left taillight remain lit (solid).

Next operation:
Turn/hazard light - Install Hazard flasher/Turn signal control module (A.40.A)

Turn/hazard light - Install Hazard flasher/Turn signal control module

Prior operation:
Turn/hazard light - Test Hazard flasher/Turn signal control module (A.40.A)

1. Plug the tractor wire harness connector, **(1)**, into the control module, **(2)**.
2. Connect the negative (-) battery cable to the negative (-) battery terminal.



200900106 1

LIGHTING SYSTEM - Troubleshooting Lighting circuit

Problem	Possible Cause	Correction
Front road lamps will not illuminate or are dim	Insufficient battery charge.	Test battery. Charge, add water, or replace as necessary.
	Road lamp bulb faulty.	Check and replace bulb as necessary.
	Blown fusible link.	Inspect fusible link and replace as necessary.
	Blown fuse head/park, **20 A** fuse.	Replace fuse as necessary.
	Defective light switch.	Test light switch and replace as necessary.
	Improper connection at work lamp terminals or headlight socket.	Check connections and lamp socket. Repair or replace as necessary.
	Improper ground connection.	Check ground connections and repair as necessary.
Rear taillights will not illuminate or are dim	Insufficient battery charge.	Test battery. Charge, add water, or replace as necessary.
	Taillight bulb fault.	Check and replace bulb as necessary.
	Blown fusible link.	Inspect fusible link and replace as necessary.
	Blown fuse head/park, **20 A** fuse.	Replace fuse as necessary.
	Defective light switch.	Test light switch and replace as necessary.
	Improper connection at taillight lamp terminals or lamp socket.	Check connections and lamp socket. Repair or replace as necessary.
	Improper ground connection.	Check ground connections and repair as necessary.
Instrument panel illumination light not illuminated or is dim	Insufficient battery charge.	Test battery. Charge, add water, or replace as necessary.
	Instrument panel illumination bulb burnt out.	Check and replace bulb as necessary.
	Blown fuse head/park, **20 A** fuse.	Replace fuse as necessary.
	Defective light switch.	Test light switch and replace as necessary.
	Improper connection at instrument panel terminals or light socket	Check connections and socket. Repair or replace as necessary.
	Improper ground connection	Check ground connections and repair as necessary.

Turn/hazard light - Troubleshooting Hazard lighting circuit

Problem	Possible Cause	Correction
Hazard Signal Lights will not illuminate or flash	Blown fuse hazard, **15 A** hazard signal fuse.	Inspect fuse and replace as necessary.
	Hazard signal bulb(s) burnt out.	Inspect bulb(s) and replace as necessary.
	Defective hazard switch.	Test switch and replace as necessary.
	Defective flasher cutoff relay.	Test flasher relay by using a known functioning flasher relay and replace as necessary.
	Defective hazard/turn flasher module.	Test module and replace as necessary.
	Faulty wiring or ground connection.	Inspect the tractor’s wiring harness and ground terminals for damage, corrosion, and short circuits. Repair or replace as needed.
Instrument panel hazard indicator(s) does not illuminate	Indicator bulb(s) burnt out	Inspect bulb and replace as necessary
	Faulty wiring or ground connection	Inspect the tractor s wiring harness and ground terminals for damage, corrosion, and short circuits. Repair or replace as needed

Turn/hazard light - Troubleshooting Right turn signal circuit

Problem	Possible Cause	Correction
Directional signal will not illuminate or flash	Blown fuse turn/horn, **15 A** hazard or directional signal fuse.	Inspect fuse and replace as necessary.
	Blown fuse hazard, **15 A** fuse.	Inspect fuse and replace as necessary.
	Directional signal bulb burnt out.	Inspect bulb and replace as necessary.
	Defective directional signal switch.	Test switch and replace as necessary.
	Defective hazard/turn flasher module.	Test module and replace as necessary.
	Faulty wiring or ground connection.	Inspect the tractor’s wiring harness and ground terminals for damage, corrosion, and short circuits. Repair or replace as needed.
Instrument panel turn indicator does not illuminate	Indicator bulb burnt out.	Inspect bulb and replace as necessary.
	Faulty wiring or ground connection.	Inspect the tractor’s wiring harness and ground terminals for damage, corrosion, and short circuits. Repair or replace as needed.

Turn/hazard light - Troubleshooting Left turn signal circuit

Problem	Possible Cause	Correction
Directional signal will not illuminate or flash	Blown fuse turn/horn, **15 A** hazard or directional signal fuse.	Inspect fuse and replace as necessary.
	Blown fuse hazard, **15 A** fuse.	Inspect fuse and replace as necessary.
	Directional signal bulb burnt out.	Inspect bulb and replace as necessary.
	Defective directional signal switch.	Test switch and replace as necessary.
	Defective hazard/turn flasher module.	Test module and replace as necessary.
	Faulty wiring or ground connection.	Inspect the tractor’s wiring harness and ground terminals for damage, corrosion, and short circuits. Repair or replace as needed.

Problem	Possible Cause	Correction
Instrument panel turn indicator does not illuminate	Indicator bulb burnt out.	Inspect bulb and replace as necessary.
	Faulty wiring or ground connection.	Inspect the tractor’s wiring harness and ground terminals for damage, corrosion, and short circuits. Repair or replace as needed.

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SERVICE - Technical Publications & Tools

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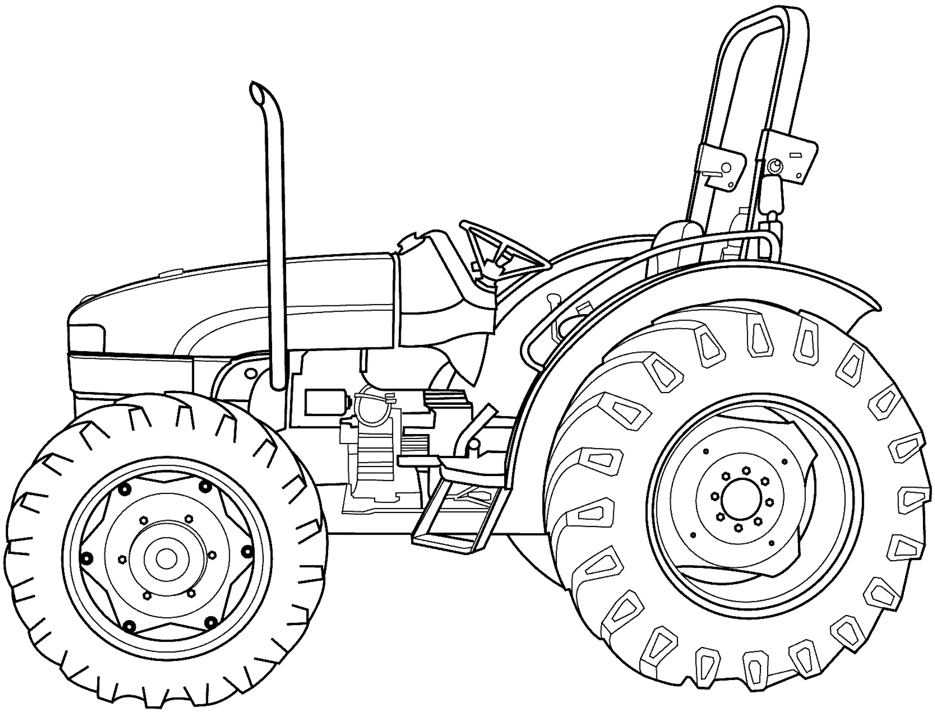
SERVICE MANUAL

ENGINE AND PTO IN



Workmaster 45
Workmaster 55

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ENGINE - General specification

General	WORKMASTER 45	WORKMASTER 55
Engine Model	ISM N844L	ISM N844LT
Number of Cylinders	4	4
Bore x Stroke	**84 mm** x **100 mm** (**3.31 in** x **3.94 in**)	**84 mm** x **100 mm** (**3.31 in** x **3.94 in**)
Displacement	**2216 cm³** (**135.2 in³**)	**2216 cm³** (**135.2 in³**)
Compression Ratio	22.4:1	23.4:1
Rated Speed	**2700 RPM**	**2700 RPM**
Gross Engine Horsepower	**33.6 kW** (**45.7 Hp**)	**41 kW** (**55.7 Hp**)
PTO Horsepower at 2250 Engine and 766 PTO rpm	**26.1 kW** (**35.5 Hp**)	**31.3 kW** (**42.6 Hp**)
Firing Order	1-3-4-2	1-3-4-2
Low Idle Speed	**1050±50 RPM**	**1100±50 RPM**
Maximum No-Load Speed	**2900~2950 RPM**	**2900~2950 RPM**
Cylinder Arrangement	In-Line Vertical	In-Line Vertical
Valve Arrangement	Overhead	Overhead
Compression Pressure at **200 RPM**(cylinder speed)	**2944 ± 345 kPa** (**427 ± 50 psi**)	**2944 ± 345 kPa** (**427 ± 50 psi**)
Variation between cylinders	**345 kPa** (**50 psi**)	**345 kPa** (**50 psi**)

NOTE: *If bore size exceeds* ***85.2 mm*** *(****3.3543 in****) replace with long block.*

ENGINE - Torque

	WORKMASTER 45	WORKMASTER 55
Engine Model	ISM N844L	ISM N844LT
TORQUE SPECIFICATION		
Connecting Rod Cap Bolts	**49 - 54 N·m** (**36 - 40 lb ft**)	**49 - 54 N·m** (**36 - 40 lb ft**)
Main Bearing Retaining Bolts	**49 - 54 N·m** (**36 - 40 lb ft**)	**49 - 54 N·m** (**36 - 40 lb ft**)
Relief Valve Assembly	**59 - 69 N·m** (**43 - 51 lb ft**)	**59 - 69 N·m** (**43 - 51 lb ft**)
Crankshaft Main Bearing Holder Bolts		
Rear Main	**25 - 29 N·m** (**18 - 22 lb ft**)	**25 - 29 N·m** (**18 - 22 lb ft**)
Center Mains	**49 - 54 N·m** (**36 - 40 lb ft**)	**49 - 54 N·m** (**36 - 40 lb ft**)
Engine Rear Mounting Plate	**12 - 17 N·m** (**9 - 12 lb ft**)	**12 - 17 N·m** (**9 - 12 lb ft**)
Flywheel Retaining Bolts	**68 - 78 N·m** (**51 - 58 lb ft**)	**68 - 78 N·m** (**51 - 58 lb ft**)
Engine Front Plate	**9 - 12 N·m** (**6 - 9 lb ft**)	**9 - 12 N·m** (**6 - 9 lb ft**)
Crankshaft Pulley Nut	**274 - 333 N·m** (**202 - 246 lb ft**)	**274 - 333 N·m** (**202 - 246 lb ft**)
Cylinder Head Bolts	**98 - 103 N·m** (**72.3 - 76 lb ft**)	**98 - 103 N·m** (**72.3 - 76 lb ft**)
Rocker Arm Assembly	**27 - 39 N·m** (**20 - 29 lb ft**)	**27 - 39 N·m** (**20 - 29 lb ft**)
Rocker Arm Locknut	**11 - 16 N·m** (**8 - 12 lb ft**)	**11 - 16 N·m** (**8 - 12 lb ft**)

	WORKMASTER 45	WORKMASTER 55
Oil Tube Banjo Bolt	**9 - 13 N·m** (**7 - 9 lb ft**)	**9 - 13 N·m** (**7 - 9 lb ft**)
Oil Pressure Switch	**14 - 20 N·m** (**10 - 14 lb ft**)	**14 - 20 N·m** (**10 - 14 lb ft**)
Rocker Cover Bolts	**7 - 12 N·m** (**6 - 9 lb ft**)	**7 - 12 N·m** (**6 - 9 lb ft**)
Glow Plugs	**14 - 20 N·m** (**10 - 14 lb ft**)	**14 - 20 N·m** (**10 - 14 lb ft**)
Cooling Fan Bolts	**9 - 13 N·m** (**7 - 9 lb ft**)	**9 - 13 N·m** (**7 - 9 lb ft**)
Balancer		
Retaining Bolts	**49 - 53.9 N·m** (**36 - 39 lb ft**)	**49 - 53.9 N·m** (**36 - 39 lb ft**)

Metric Bolt Torque Specifications

		Coarse Thread Fine Thread		Fine Thread	
Bolt Size	**Grade No.**	**Pitch**	**Torque**	**Pitch**	**Torque**
	4T		**4.9 - 6.9 N·m (3.6 - 5.1 lb ft)**		
M6	7T	1.0	**8.3 - 11.3 N·m (6.1 - 8.3 lb ft)**		
	10T		**11.8 - 15.7 N·m (8.7 - 11.6 lb ft)**		
	4T		**12.7 - 16.7 N·m (9.4 - 12.3 lb ft)**		**15.2 - 20.1 N·m (11.2 - 14.8 lb ft)**
M8	7T	1.25	**22.6 - 28.4 N·m (16.6 - 21.0 lb ft)**	1.0	**26.5 - 34.3 N·m (19.5 - 25.3 lb ft)**
	10T		**28.4 - 36.3 N·m (21.0 - 26.8 lb ft)**		**30.4 - 40.2 N·m (22.4 - 29.7 lb ft)**
	4T		**25.5 - 33.3 N·m (18.8 - 24.6 lb ft)**		**28.4 - 36.3 N·m (21.0 - 26.8 lb ft)**
M10	7T	1.5	**44.1 - 55.9 N·m (32.5 - 41.2 lb ft)**	1.25	**49.0 - 62.8 N·m (36.2 - 46.3 lb ft)**
	10T		**53.9 - 69.6 N·m (39.8 - 51.4 lb ft)**		**57.9 - 73.5 N·m (42.7 - 54.2 lb ft)**
	4T		**37.3 - 47.1 N·m (27.5 - 34.7 lb ft)**		**43.1 - 54.9 N·m (31.8 - 40.5 lb ft)**
M12	7T	1.75	**65.7 - 83.4 N·m (48.5 - 61.5 lb ft)**	1.25	**74.5 - 94.1 N·m (55.0 - 69.4 lb ft)**
	10T		**92.2 - 116 N·m (68.0 - 85.4 lb ft)**		**99.0 - 127 N·m (73.1 - 93.3 lb ft)**
	4T		**62.8 - 80.4 N·m (46.3 - 59.3 lb ft)**		**69.6 - 87.3 N·m (51.4 - 64.4 lb ft)**
M14	7T	2.0	**104 - 131 N·m (76.7 - 96.9 lb ft)**	1.5	**117 - 148 N·m (86.1 - 109 lb ft)**
	11T		**139 - 175 N·m (102 - 129 lb ft)**		**147 - 186 N·m (108 - 137 lb ft)**
	4T		**86.3 - 110 N·m (63.6 - 81.0 lb ft)**		**91.2 - 115 N·m (67.3 - 84.6 lb ft)**
M16	7T	2.0	**140 - 184 N·m (110 - 136 lb ft)**	1.5	**157 - 192 N·m (116 - 142 lb ft)**
	11T		**206 - 255 N·m (152 - 188 lb ft)**		**221 - 270 N·m (163 - 199 lb ft)**
	4T		**114 - 141 N·m (83.9 - 104 lb ft)**		**131 - 163 N·m (96.9 - 120 lb ft)**
M18	7T	2.0	**196 - 235 N·m (145 - 174 lb ft)**	1.5	**230 - 279 N·m (170 - 206 lb ft)**
	11T		**275 - 333 N·m (203 - 246 lb ft)**		**299 - 368 N·m (221 - 271 lb ft)**
	4T		**144 - 179 N·m (106 - 132 lb ft)**		**172 - 211 N·m (127 - 156 lb ft)**
M20	7T	2.5	**240 - 289 N·m (177 - 213 lb ft)**	1.5	**275 - 333 N·m (203 - 246 lb ft)**
	11T		**363 - 441 N·m (268 - 325 lb ft)**		**397 - 485 N·m (293 - 358 lb ft)**

ENGINE - Special tools

Tool No.	Description
FNH01721	Injector Tester
FNH00120	Adapter - Compression Tester
FNH01728	Injector Adapter Set
OEM1074	Compression Test Gauge Assembly
FNH01720	Injector Cleaning Kit
380002887	Port Block Installer
FNH11044	Port Block Installer Pins
380002888	Port Block Remover
FNH00011	Oil Pressure Test Fitting
Micrometer, Outside	**0 - 25 mm** (**0 - 1 in**)
Micrometer, Outside	**25 - 51 mm** (**1 - 2 in**)
Micrometer, Outside	**76.2 - 101.6 mm** (**3 - 4 in**)
Small Hole Gauge	**19 - 25 mm** (**0.75 - 1 in**)
Cylinder Bore Gauge	**76.2 - 101.6 mm** (**3 - 4 in**)
Cylinder Bore Gauge	**25 - 51 mm** (**1 - 2 in**)

Valve drive - Dimension

Camshaft

	WORKMASTER 45	**WORKMASTER 55**
Engine Model	ISM N844L	ISM N844LT
Cam Height-Valve		
Standard	**34.433 - 34.508 mm** (**1.3564 - 1.3586 in**)	**34.433 - 34.508 mm** (**1.3564 - 1.3586 in**)
Minimum	**34.1 mm** (**1.3425 in**)	**34.1 mm** (**1.3425 in**)
Bend		
Standard	**0.03 mm** (**0.001 in**)	**0.03 mm** (**0.001 in**)
Maximum	**0.1 mm** (**0.004 in**)	**0.1 mm** (**0.004 in**)
Cam Height-Fuel		
Standard	**42.94 - 43.06 mm** (**1.6905 - 1.6953 in**)	**42.94 - 43.06 mm** (**1.6905 - 1.6953 in**)
Minimum	**42.8 mm** (**1.6850 in**)	**42.8 mm** (**1.6850 in**)

Valves

	WORKMASTER 45	**WORKMASTER 55**
Engine Model	ISM N844L	ISM N844LT
Stem Diameter-Intake		
Standard	**6.95 - 6.97 mm** (**0.2738 - 0.2744 in**)	**6.95 - 6.97 mm** (**0.2738 - 0.2744 in**)
Minimum	**6.89 mm** (**0.271 in**)	**6.89 mm** (**0.271 in**)
Stem Diameter-Exhaust		
Standard	**6.94 - 6.95 mm** (**0.273 - 0.274 in**)	**6.94 - 6.95 mm** (**0.273 - 0.274 in**)
Minimum	**6.84 mm** (**0.269 in**)	**6.84 mm** (**0.269 in**)
Guide Clearance-Intake		
Standard	**0.03 - 0.06 mm** (**0.001 - 0.002 in**)	**0.03 - 0.06 mm** (**0.001 - 0.002 in**)
Maximum	**0.2 mm** (**0.008 in**)	**0.2 mm** (**0.008 in**)
Guide Clearance-Exhaust		
Standard	**0.0451 - 0.075 mm** (**0.0018 - 0.0029 in**)	**0.0451 - 0.075 mm** (**0.0018 - 0.0029 in**)
Maximum	**0.25 mm** (**0.01 in**)	**0.25 mm** (**0.01 in**)
Valve Margin (Thickness)		
Standard	**0.775 - 1.075 mm** (**0.0305 - 0.0423 in**)	**0.775 - 1.075 mm** (**0.0305 - 0.0423 in**)
Minimum	**0.5 mm** (**0.0197 in**)	**0.5 mm** (**0.0197 in**)
Valve Lash Cold Condition	**0.2 mm** (**0.008 in**)	**0.2 mm** (**0.008 in**)
Valve Spring-Free Height		
Standard	**35 mm** (**1.378 in**)	**35 mm** (**1.378 in**)
Minimum	**33.5 mm** (**1.319 in**)	**33.5 mm** (**1.319 in**)
Valve Spring-Squareness		
Standard	**1.2 mm** (**0.0472 in**)	**1.2 mm** (**0.0472 in**)
Maximum	**2.0 mm** (**0.079 in**)	**2.0 mm** (**0.079 in**)
Valve Timing-Intake		
Open Before TDC	10°	10°
Close After BDC	46°	46°
Valve Timing-Exhaust		
Open Before TDC	40°	40°
Close After BDC	16°	16°
Valve Spring-Compressed Load Required to Compress Spring to 30.4 mm (1.2 in)		
Standard	**8.1 kg** (**17.85 lb**)	**8.1 kg** (**17.85 lb**)
Minimum	**7 kg** (**15.43 lb**)	**7 kg** (**15.43 lb**)

Push Rods

	WORKMASTER 45	WORKMASTER 55
Engine Model	ISM N844L	ISM N844LT
Length	**205.1 - 205.9 mm** (**8.075 - 8.11 in**)	**225.6 - 226.4 mm** (**8.882 - 8.913 in**)
Diameter	**6.3 mm** (**0.248 in**)	**6.3 mm** (**0.248 in**)

Rocker Arm

	WORKMASTER 45	WORKMASTER 55
Engine Model	ISM N844L	ISM N844LT
Shaft Diameter		
Standard	**14.95 - 14.968 mm** (**0.5886 - 0.5893 in**)	**14.95 - 14.968 mm** (**0.5886 - 0.5893 in**)
Minimum	**14.87 mm** (**0.585 in**)	**14.87 mm** (**0.585 in**)
Shaft-to-Rocker Clearance		
Standard	**0.032 - 0.068 mm** (**0.00126 - 0.00268 in**)	**0.032 - 0.068 mm** (**0.00126 - 0.00268 in**)
Maximum	**0.2 mm** (**0.008 in**)	**0.2 mm** (**0.008 in**)

Crankshaft - Dimension

	WORKMASTER 45	WORKMASTER 55
Engine Model	ISM N844L	ISM N844LT
Journal Diameter		
Standard	**67.957 - 67.97 mm** (**2.6754 - 2.676 in**)	**67.957 - 67.97 mm** (**2.6754 - 2.676 in**)
Maximum	**67.9 mm** (**2.673 in**)	**67.9 mm** (**2.673 in**)
Crankpin Diameter		
Standard	**51.964 - 51.975 mm** (**2.0458 - 2.0462 in**)	**51.964 - 51.975 mm** (**2.0458 - 2.0462 in**)
Maximum	**51.9 mm** (**2.043 in**)	**51.9 mm** (**2.043 in**)
Runout		
Standard	**0.03 mm** (**0.0012 in**)	**0.03 mm** (**0.0012 in**)
Maximum	**0.06 mm** (**0.0023 in**)	**0.06 mm** (**0.0023 in**)
Endplay		
Standard	**0.1 - 0.4 mm** (**0.0039 - 0.0156 in**)	**0.1 - 0.4 mm** (**0.0039 - 0.0156 in**)
Maximum	**0.5 mm** (**0.0195 in**)	**0.5 mm** (**0.0195 in**)
Thrust Washer Thickness		
Standard	**2.95 - 3.0 mm** (**0.115 - 0.117 in**)	**2.95 - 3.0 mm** (**0.115 - 0.117 in**)
Minimum	**2.8 mm** (**0.109 in**)	**2.8 mm** (**0.109 in**)
Cylinder Block Bearing Diameter		
Standard	**68 mm** x **72 mm** (**2.677 in** x **2.835 in**	**68 mm** x **72 mm** (**2.677 in** x **2.835 in**
Journal-to-Cylinder Block Bearing Clearance		
Standard	**0.044 - 0.116 mm** (**0.0017 - 0.0046 in**)	**0.044 - 0.116 mm** (**0.0017 - 0.0046 in**)
Maximum	**0.2 mm** (**0.0079 in**)	**0.2 mm** (**0.0079 in**)
Main Journal Regrind Size		
0.25 mm (**0.010 in**) undersize	**67.707 - 67.720 mm** (**2.6656 - 2.6661 in**)	**67.707 - 67.720 mm** (**2.6656 - 2.6661 in**)
Maximum	**67.65 mm** (**2.663 in**)	**67.65 mm** (**2.663 in**)
0.5 mm (**0.020 in**) undersize	**67.457 - 67.470 mm** (**2.6558 - 2.6563 in**)	**67.457 - 67.470 mm** (**2.6558 - 2.6563 in**)
Maximum	**67.4 mm** (**2.654 in**)	**67.4 mm** (**2.654 in**)
Crankpin Regrind Size		
0.25 mm (**0.010 in**) undersize	**51.714 - 51.725 mm** (**2.0360 - 2.0364 in**)	**51.714 - 51.725 mm** (**2.0360 - 2.0364 in**)
Maximum	**51.65 mm** (**2.0335 in**)	**51.65 mm** (**2.0335 in**)
0.5 mm (**0.020 in**) undersize	**51.464 - 51.475 mm** (**2.0261 - 2.0266 in**)	**51.464 - 51.475 mm** (**2.0261 - 2.0266 in**)
Maximum	**51.40 mm** (**2.0236 in**)	**51.40 mm** (**2.0236 in**)
Center Bearing to Crankshaft Clearance		

	WORKMASTER 45	WORKMASTER 55
Standard	**0.044 - 0.102 mm** (**0.001732 - 0.004016 in**)	**0.044 - 0.102 mm** (**0.001732 - 0.004016 in**)
Maximum	**0.2 mm** (**0.0079 in**)	**0.2 mm** (**0.0079 in**)
Dynamic Balancer		
Counterweight gear backlash	**0.2 - 0.4 mm** (**0.008 - 0.016 in**)	**0.2 - 0.4 mm** (**0.008 - 0.016 in**)
Maximum	**0.4 mm** (**0.016 in**)	**0.4 mm** (**0.016 in**)

NOTE: ** Center Bearing to Crankshaft Clearance*

Connecting rod and piston - Dimension

PISTON

	WORKMASTER 45	WORKMASTER 55
Engine Model	ISM N844L	ISM N844LT
Diameter		
Standard	**83.948 - 83.963 mm** (**3.30503 - 3.30562 in**)	**83.948 - 83.963 mm** (**3.30503 - 3.30562 in**)
Minimum	**83.7 mm** (**3.2953 in**)	**83.7 mm** (**3.2953 in**)
Bore Clearance		
Standard	**0.038 - 0.072 mm** (**0.0014 - 0.0028 in**)	**0.038 - 0.072 mm** (**0.0014 - 0.0028 in**)
Maximum	**0.25 mm** (**0.010 in**)	**0.25 mm** (**0.010 in**)
Piston Pin Bore		
Standard	**27.996 - 28.000 mm** (**1.102 - 1.1023 in**)	**27.996 - 28.000 mm** (**1.102 - 1.1023 in**)
Maximum	**27.98 mm** (**1.102 in**)	**27.98 mm** (**1.102 in**)
Piston Pin Clearance		
Standard	-0.001 + 0.007 mm (-0.000393 + 0.0002 in.)	-0.001 + 0.007 mm (-0.000393 + 0.0002 in.)
Maximum	**0.02 mm** (**0.0008 in**)	**0.02 mm** (**0.0008 in**)

PISTON PIN

	WORKMASTER 45	WORKMASTER 55
Engine Model	ISM N844L	ISM N844LT
Diameter		
Standard	**27.996 - 28.0 mm** (**1.1022 - 1.10236 in**)	**27.996 - 28.0 mm** (**1.1022 - 1.10236 in**)
Minimum	**27.98 mm** (**1.1016 in**)	**27.98 mm** (**1.1016 in**)
Pin-to-Bushing Clearance		
Standard	**0.01 - 0.025 mm** (**0.00039 - 0.00098 in**)	**0.01 - 0.025 mm** (**0.00039 - 0.00098 in**)
Maximum	**0.08 mm** (**0.0031 in**)	**0.08 mm** (**0.0031 in**)

PISTON RING

	WORKMASTER 45	WORKMASTER 55
Engine Model	ISM N844L	ISM N844LT
End Gap		
1st Ring	**0.2 - 0.35 mm (0.008 - 0.0138 in)**	**0.2 - 0.35 mm (0.008 - 0.0138 in)**
Maximum	**1.0 mm (0.039 in)**	**1.0 mm (0.039 in)**
2nd Ring	**0.20 - 0.40 mm (0.0079 - 0.0157 in)**	**0.20 - 0.40 mm (0.0079 - 0.0157 in)**
Maximum	**1.0 mm (0.039 in)**	**1.0 mm (0.039 in)**
Oil Ring	**0.20 - 0.80 mm (0.0079 - 0.0315 in)**	**0.20 - 0.80 mm (0.0079 - 0.0315 in)**
Maximum	**1.2 mm (0.047 in)**	**1.2 mm (0.047 in)**
Compression Ring-to-Groove Clearance		
Standard (1st Ring)	**0.07 - 0.11 mm (0.0027 - 0.0043 in)**	**0.07 - 0.11 mm (0.0027 - 0.0043 in)**
2nd Ring	**0.04 - 0.08 mm (0.0015 - 0.0031 in)**	**0.04 - 0.08 mm (0.0015 - 0.0031 in)**
Maximum	**0.25 mm (0.010 in)**	**0.25 mm (0.010 in)**
Oil Ring-to-Groove Clearance		
Standard	**0.03 - 0.13 mm (0.001 - 0.00512 in)**	**0.03 - 0.13 mm (0.001 - 0.00512 in)**
Maximum	**0.25 mm (0.010 in)**	**0.25 mm (0.010 in)**
Ring Width		
1st Compression	**2.0 mm (0.079 in)**	**2.0 mm (0.079 in)**
2nd Compression	**1.5 mm (0.059 in)**	**1.5 mm (0.059 in)**
Oil Compression	**4.0 mm (0.157 in)**	**4.0 mm (0.157 in)**

CONNECTING ROD

	WORKMASTER 45	WORKMASTER 55
Engine Model	ISM N844L	ISM N844LT
Rod Twist		
Standard	**0.08 mm (0.003 in)**	**0.08 mm (0.003 in)**
Maximum	**0.2 mm (0.008 in)**	**0.2 mm (0.008 in)**
Rod Bend		
Standard	**0.05 mm (0.002 in)**	**0.05 mm (0.002 in)**
Maximum	**0. mm (0.0059 in)**	**0.15 mm (0.0059 in)**
On Crankshaft Side Play		
Standard	**0.1 - 0.3 mm (0.004 - 0.012 in)**	**0.1 - 0.3 mm (0.004 - 0.012 in)**
Maximum	**0.7 mm (0.028 in)**	**0.7 mm (0.028 in)**
Crankshaft Bearing Clearance		
Standard	**0.035 - 0.083 mm (0.0014 - 0.00327 in)**	**0.035 - 0.083 mm (0.0014 - 0.00327 in)**
Maximum	**0.2 mm (0.008 in)**	**0.2 mm (0.008 in)**

Cylinder block - Dimension

	WORKMASTER 45	WORKMASTER 55
Engine Model	ISM N844L	ISM N844LT
Bore		
Standard	**84 mm** (**3.3071 - 3.3078 in**)	**84 mm**(**3.3071 - 3.3078 in**)
Maximum	**85.2 mm** (**3.3543 in**)	**85.2 mm** (**3.3543 in**)
Head Surface Warp		
Standard	**0.05 mm** (**0.002 in**)	**0.05 mm** (**0.002 in**)
Maximum	**0.12 mm** (**0.005 in**)	**0.12 mm** (**0.005 in**)

NOTE: *If bore size exceeds **85.2 mm** (**3.3543 in**) replace with long block*

Cylinder head - Dimension

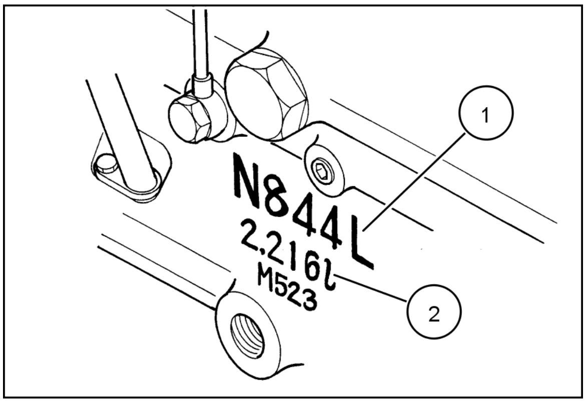
	WORKMASTER 45	WORKMASTER 55
Engine Model	ISM N844L	ISM N844LT
Head Warp		
Standard	**0.05 mm** (**0.002 in**)	**0.05 mm** (**0.002 in**)
Maximum	**0.12 mm** (**0.005 in**)	**0.12 mm** (**0.005 in**)
Valve Seat Width		
Standard	**1.7 - 2.1 mm** (**0.067 - 0.082 in**)	**1.7 - 2.1 mm** (**0.067 - 0.082 in**)
Maximum	**2.5 mm** (**0.098 in**)	**2.5 mm** (**0.098 in**)
Valve Seat Sink		
Standard (Recess)	**0.85 - 1.15 mm** (**0.0334 - 0.0453 in**)	**0.85 - 1.15 mm** (**0.0334 - 0.0453 in**)
Maximum	**1.8 mm** (**0.071 in**)	**1.8 mm** (**0.071 in**)
Valve Angle	**45 °**	**45 °**

ENGINE - Identification

Description of Operation

This section describes the engine overhaul and repair procedures of the Models WORKMASTER 45, and WORKMASTER 55 tractors. Repair procedures are essentially the same for all models except as noted in the repair procedures.

All tractors are equipped with four-cylinder in-line engines. They are all four cycle, overhead valve, liquid cooled, diesel engines. The engines are identified by a code, **(1)**, cast into the lower right side of the cylinder block.



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NOTE: *Numeric value,* ***(2)****, under the Engine Code indicates displacement of the engine in liters.*

Engine Identification	Tractor Model	Engine Power
ISM N844L	WORKMASTER 45	**45 Hp**
ISM N844LT	WORKMASTER 55	**55 Hp**

Cylinder head - Static description

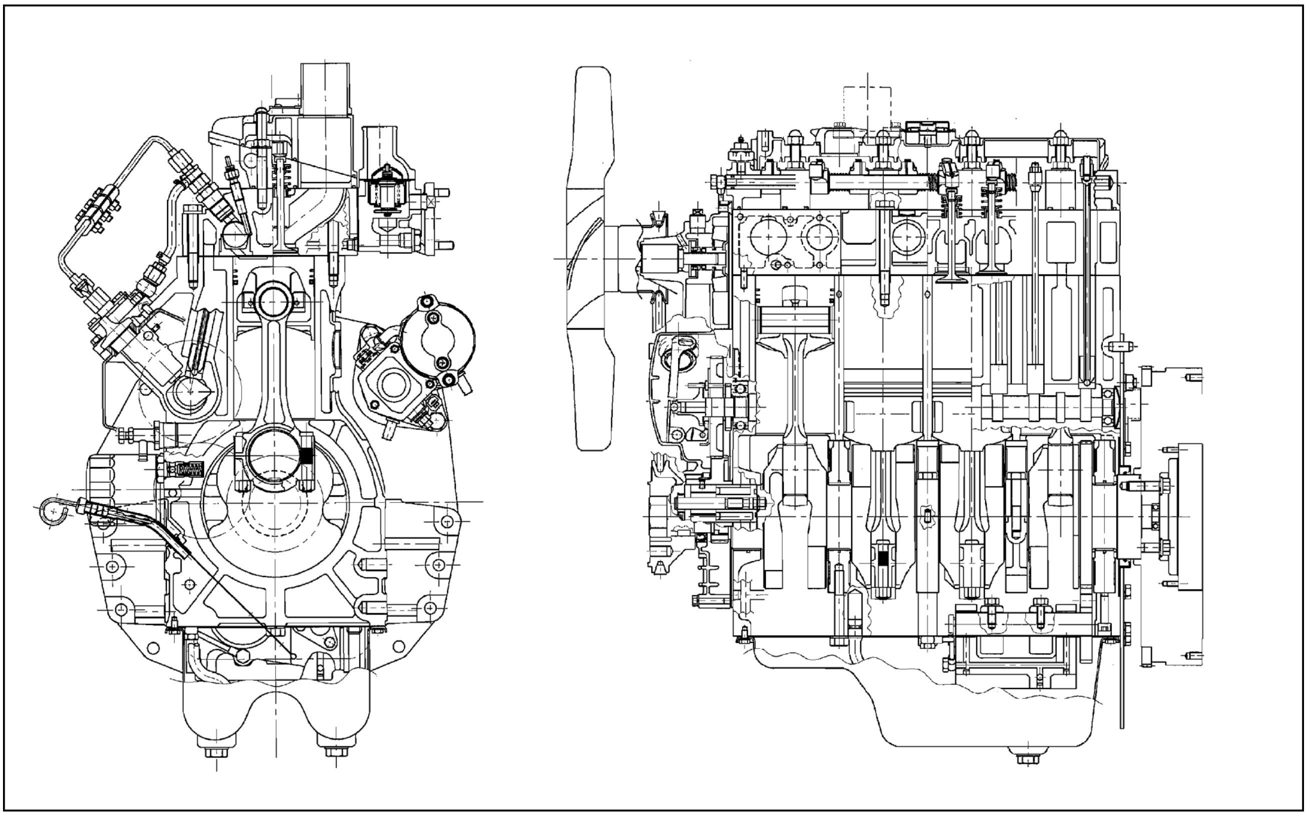
Cylinder Head and Valve Train Components

The cylinder head incorporates the valve assemblies, rocker arms, rocker shaft, push rods, and lifters. A swirl chamber located between the injector assembly and the main combustion chamber of the cylinders provides improved starting and greater fuel efficiency. Initial combustion starts in the precombustion chamber and as the expansion occurs a strong swirl pattern is created in the main combustion chamber for more complete combustion of the air-fuel mixture. The air intake manifold is separate from the cast aluminum valve cover on all these engines. The exhaust manifold is bolted on the left-hand side of the cylinder head on each of the models. Cylinder heads have integral valve guides. Standard size valves only are used.

Cylinder Block Assembly

(N844L and N844LT Engine - WORKMASTER 45 and WORKMASTER 55)

The cylinder block assembly contains the pistons, connecting rods, crankshaft, timing gears, and engine oil pump. The crankshaft is supported on five main bearings. The front bearing is positioned in a bore in front of the block. The other bearings are split liners located in holders bolted to the block. The camshaft is supported on four ball bearings located in the block.



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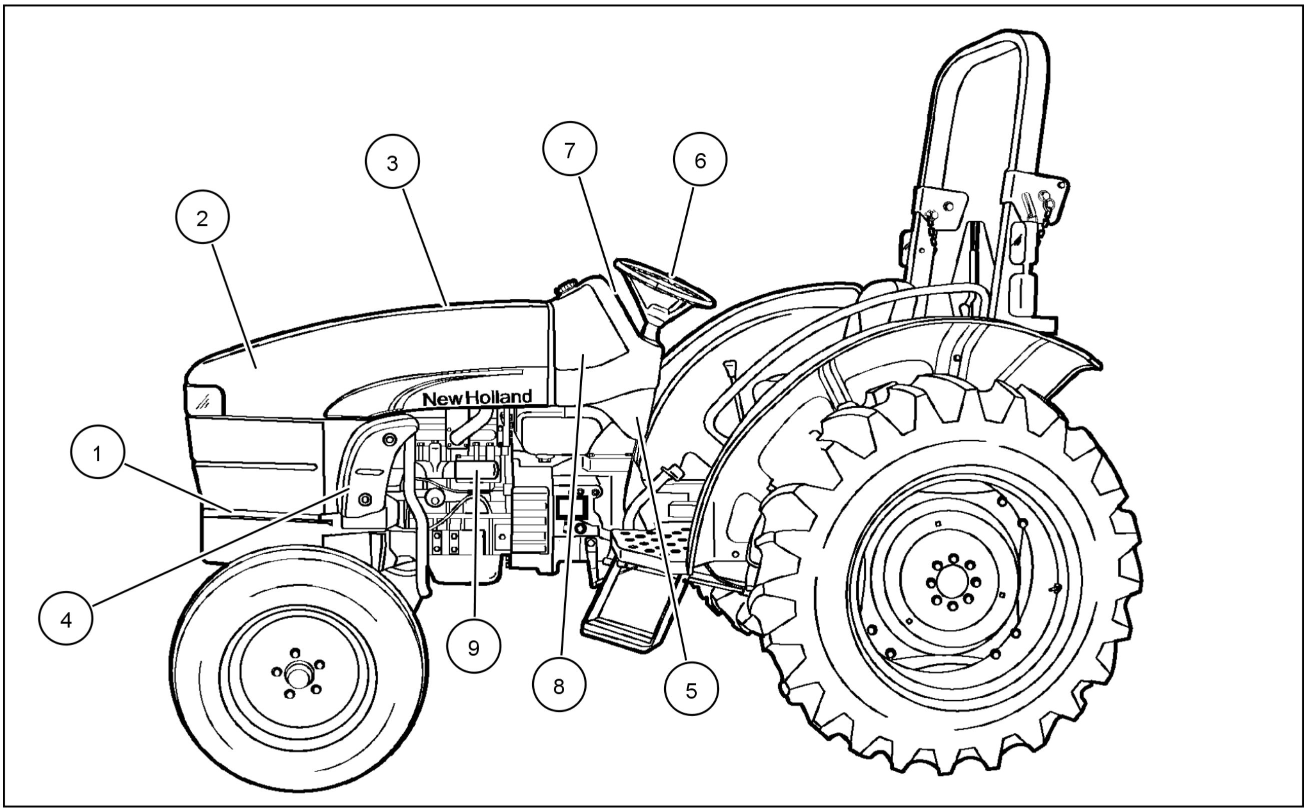
Engine models ISM N844L and ISM N844LT - WORKMASTER 45 and WORKMASTER 55

ENGINE - Remove Separating the tractor at the clutch housing/engine - 8x8 transmission

Removal



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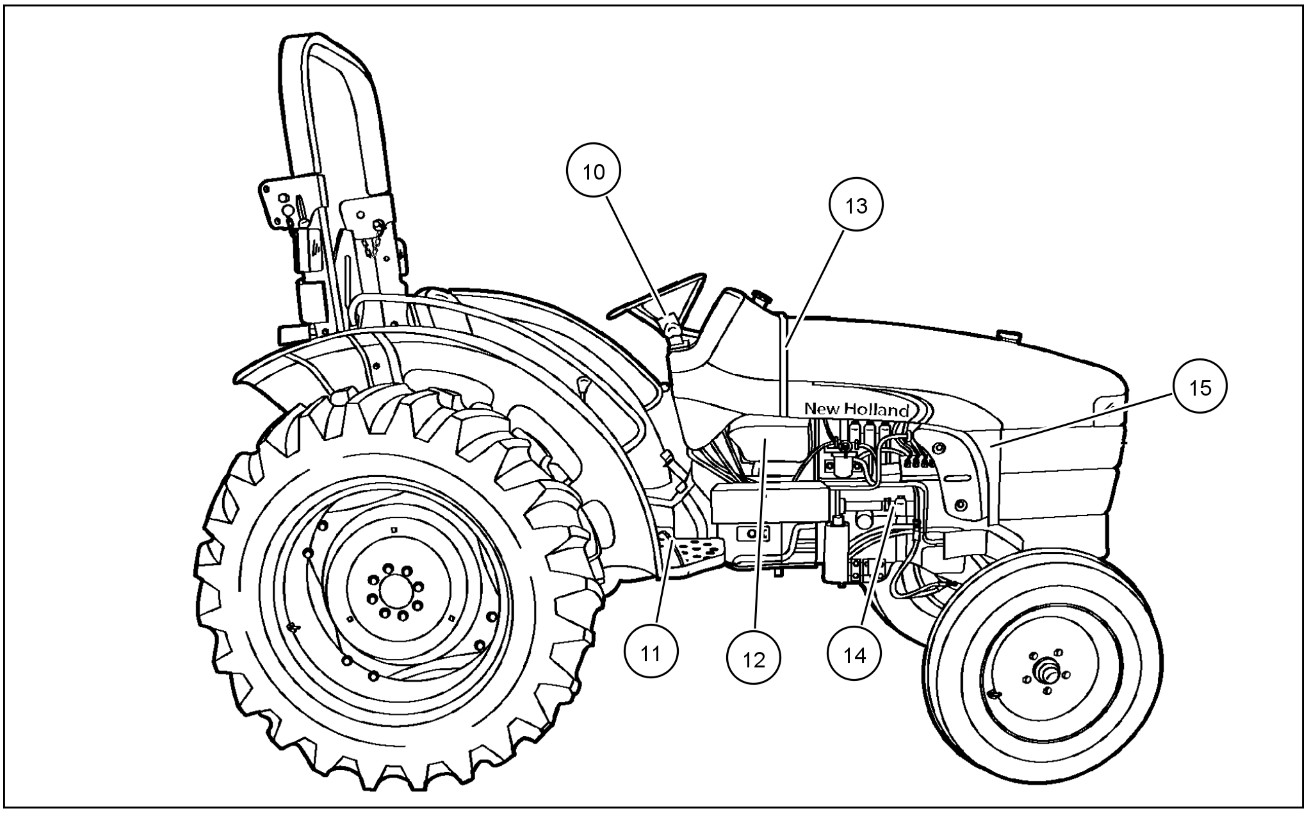
1. Disconnect the negative (-) battery cable, and the positive (+) battery cable from the battery, **(1)**.
2. Disconnect the headlight wiring harness, **(2)**, and remove the hood, **(3)**.
3. If equipped, remove the remote loader control valve, and all the connecting hydraulic tubes from the right side loader tower.
4. Remove the left-hand and right-hand engine side covers, **(4)**.
5. Remove the left-hand, right-hand and center rear hood panels, **(5)**.
6. Remove the steering wheel, **(6)**.
7. Remove the instrument panel, **(7)**, from the dash housing. Disconnect all electrical connectors from the instrument panel.
8. Remove the dash housing, **(8)**, from the firewall. Disconnect all electrical connectors from the dash housing.
9. Disconnect electrical harness to the starter, **(9)**.

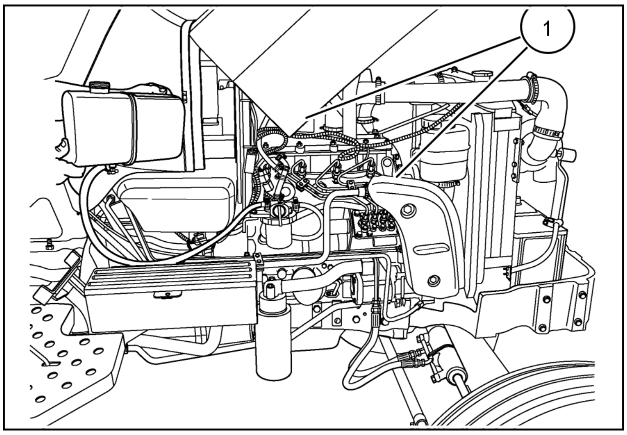


20098750 2

10. Disconnect and remove the throttle cable from the dash mounted throttle control lever, **(10)**.
11. Disconnect and remove the throttle cable from the foot control pedal, **(11)**.
12. Drain fuel from fuel tank, **(12)**, into a suitable container. Remove fuel tank from firewall.
13. Remove the firewall, **(13)**, from the tractor.
14. Disconnect all hydraulic tubes **(14)**, to the hydraulic pump, **(15)**.
15. Attach a chain sling to the two hoist eyes, **(1)**.
16. Attach a suitable hoist to the chain sling.

***NOTE:** The hoist is used for supporting the engine and axle assembly, not necessarily for lifting.*

17. Roll a floor jack under the rear of the tractor, and place under the clutch housing. Raise the jack enough to support the drive train.



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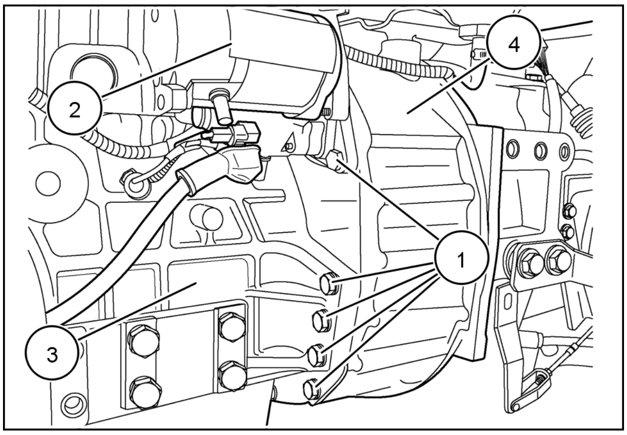
18. Remove the buckle-up bolts, **(1)**, and starter, **(2)**, that secure the engine, **(3)**, to the clutch housing, **(4)**.

NOTE: *The hoist and/or floor jack may need to be raised or lowered to allow for separation of the engine and clutch housing.*

19. Carefully roll the drive train away from the engine, using the floor jack for support.



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Next operation:
ENGINE - Remove Separating the tractor at the engine/frame (B.10.A).

ENGINE - Remove Separating the tractor at the engine/frame

Prior operation:
ENGINE - Remove Separating the tractor at the clutch housing/engine - 8x8 transmission (B.10.A)

1. Use jack stands under the frame rails to support the front frame/engine assembly.

⚠ WARNING ⚠

The front frame/engine assembly is extremely heavy and awkward. Make sure the assembly is securely supported before removing chain sling from engine. Failure to comply could result in death or serious injury.

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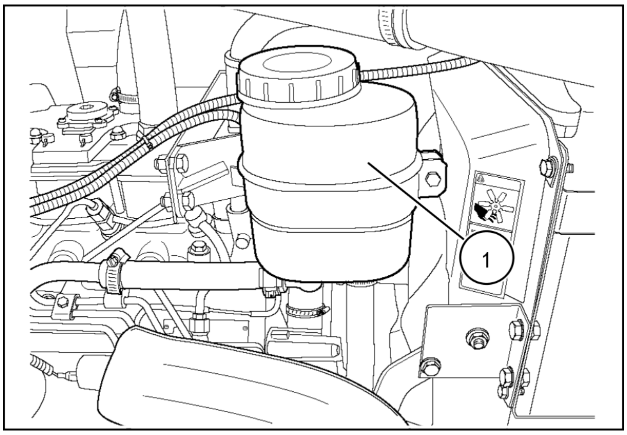
2. Remove the chain sling from the two hoist eyes on the engine.
3. Drain the hydraulic fluid from the power steering reservoir, **(1)**, into a suitable container. Remove the reservoir, **(1)**, and mounting bracket from the engine.



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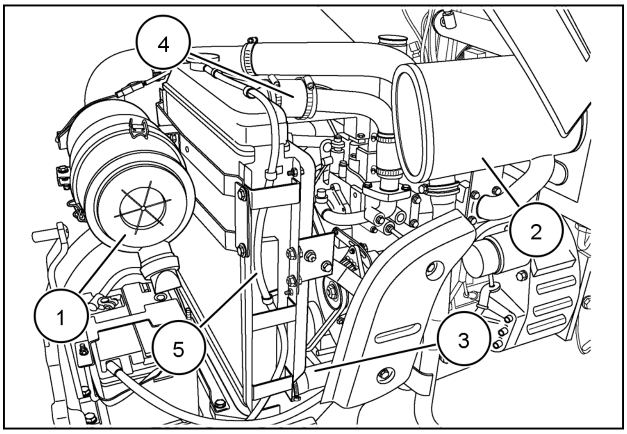
4. Remove the air cleaner assembly, **(1)**, from the tractor.
5. Remove the muffler and tailpipe assembly, **(2)**, from engine.
6. Loosen the lower radiator hose, **(3)**, and drain the coolant into a suitable container.
7. Remove the lower, **(3)**, and upper, **(4)**, radiator hoses.
8. Remove the radiator, **(5)**, from the tractor.



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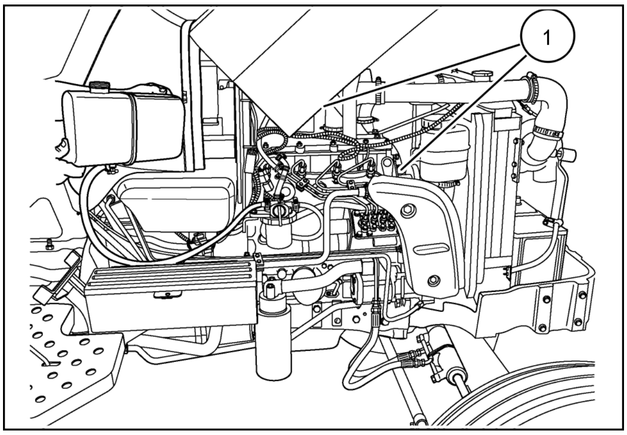
9. Attach a chain sling to the two hoist eyes, **(1)**.
10. Attach a suitable hoist to the chain sling, and raise the engine enough to support the engine.



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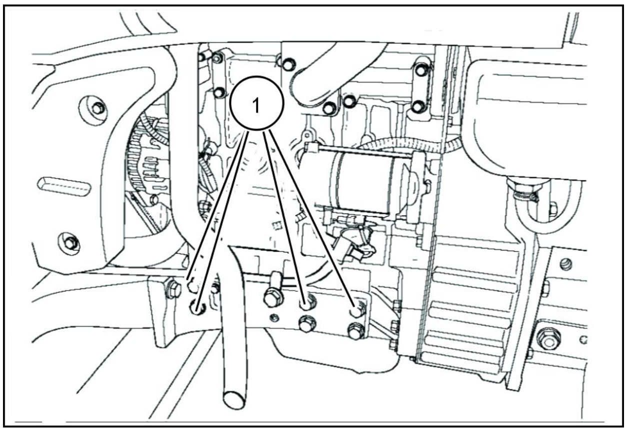
11. Loosen and remove the engine mounting bolts, **(1)**, on both sides of the frame.
12. Carefully lift the engine from the frame.
13. Attach the engine to a suitable engine stand.
14. With the engine securely attached to the engine stand, remove the chain sling from the two engine hoist eyes.



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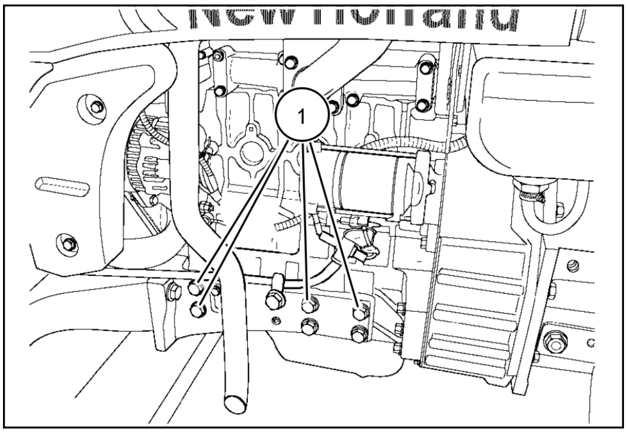
Next operation:
ENGINE - Install - To frame (B.10.A)

ENGINE - Install - To frame

Prior operation:
ENGINE - Remove Separating the tractor at the engine/frame (B.10.A)

1. Attach a chain sling to the two hoist eyes on the engine.
2. Attach a suitable hoist to the chain sling and raise the hoist enough to support the engine.
3. Remove the engine from the engine stand.
4. Using the hoist, position the engine in the frame, aligning the mounting holes in the frame with the mounting holes in the engine.
5. Install the engine mounting bolts **(1)**, on both sides of the frame. Tighten the mounting bolts to **139 - 175 N·m** (**102 - 129 lb ft**).
6. With the engine securely installed into the frame, remove the chain sling from the two engine hoist eyes.



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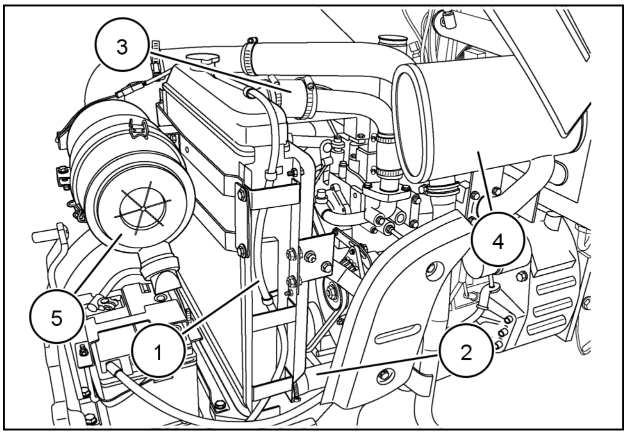
7. Reinstall the radiator, **(1)**, into the tractor.
8. Reinstall the lower, **(2)**, and upper, **(3)**, radiator hoses.
9. Fill the radiator, **(1)**, with new coolant to the proper level.
10. Reinstall the muffler and exhaust pipe, **(4)**, onto the exhaust manifold.
11. Reinstall the air cleaner assembly, **(5)**, onto the engine.



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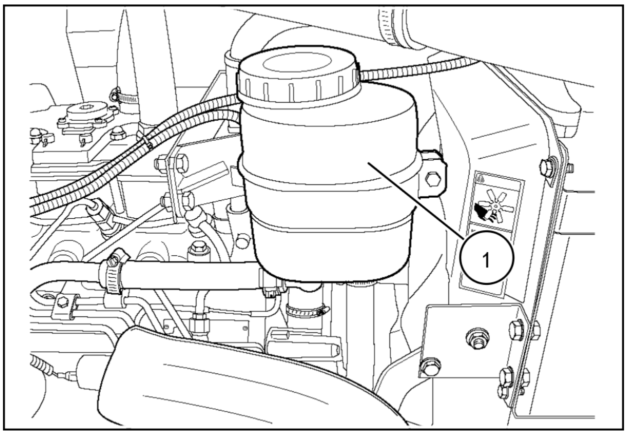
12. Reinstall the power steering reservoir and mounting bracket, **(1)**, onto the engine. Reconnect the hydraulic lines to the reservoir.
13. Refill the reservoir to the proper level with **NEW HOLLAND AMBRA MULTI G 134**.



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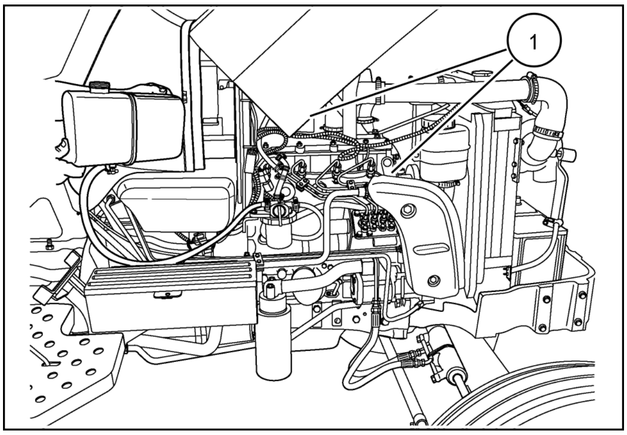
Next operation:
ENGINE - Install - Attaching the tractor at the clutch housing/engine - 8x8 transmission (B.10.A)

ENGINE - Install - Attaching the tractor at the clutch housing/engine - 8x8 transmission

Prior operation:
ENGINE - Remove Separating the tractor at the clutch housing/engine - 8x8 transmission (B.10.A)

NOTICE: *Do not use the buckle-up bolts to draw the drive train together with the engine. Severe damage to the drive train may result.*

1. Attach a chain sling to the two hoist eyes, **(1)**, on the engine.
2. Attach a suitable hoist to the chain sling.
3. Carefully roll the drive train into alignment with the engine. Align the splines on the 8x8 input shaft with the clutch and the engine flywheel. Rotate the engine fan to align the input shaft and the clutch/flywheel. The floor jack or the hoist may need to be raised or lowered to make alignment possible.



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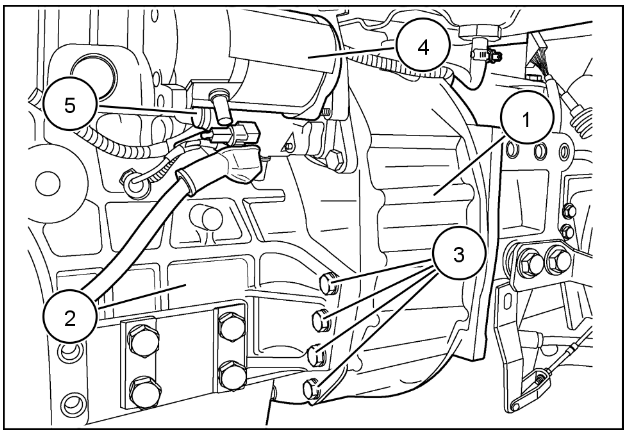
4. Connect the clutch housing, **(1)**, to the engine, **(2)**, and install the bucket-up bolts, **(3)**.
5. Reinstall the starter, **(4)**, and secure with the retaining nuts. Connect the wiring harness, **(5)**, to the starter.
6. Tighten the buckle-up bolts, **(3)**, in a criss--cross pattern. Torque theM10 bolts and nuts to **68 N·m** (**50 lb ft**). Torque the M12 bolts to **81 N·m** (**60 lb ft**).
7. Remove the chain hoist and sling from the engine hoist eyes. Remove the floor jack from under the tractor.



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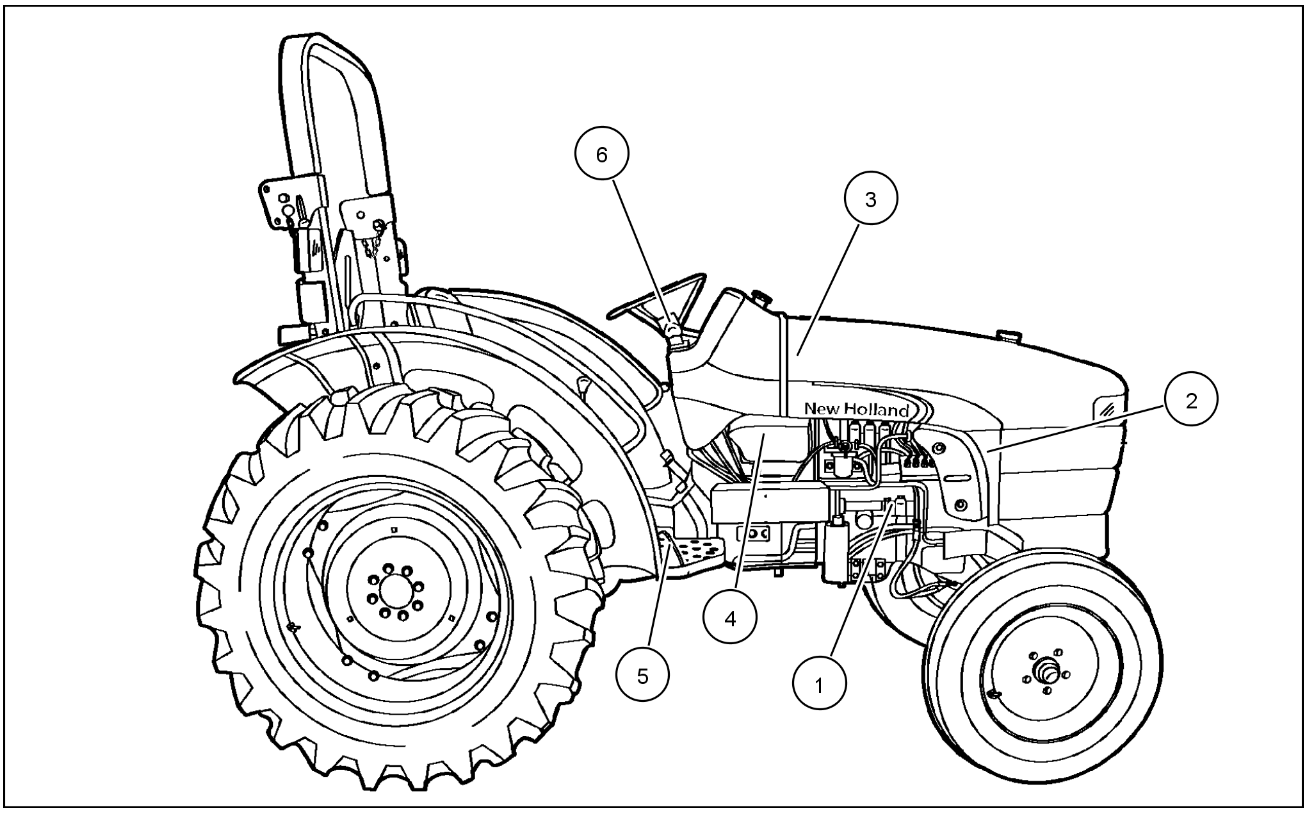

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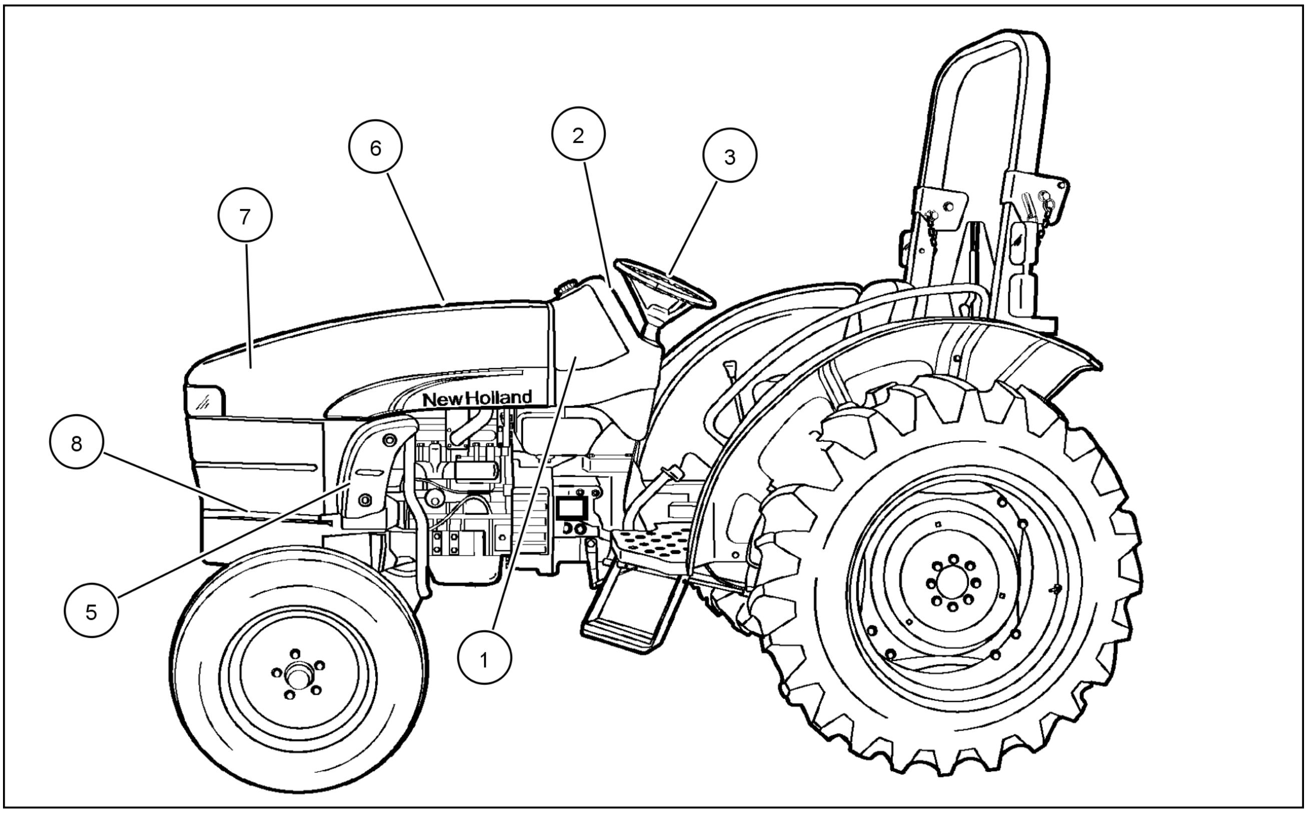
8. Reconnect all hydraulic tubes, **(1)**, to the hydraulic pump, **(2)**.
9. Reattach the firewall, **(3)**, to the tractor.
10. Reattach the fuel tank, **(4)**, to the firewall. Reconnect fuel lines to the fuel shut--off valve and tank vent.
11. Reattach the throttle cable to the foot control pedal, **(5)**.
12. Reattach the throttle cable to the dash mounted throttle control lever, **(6)**.



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13. Reconnect all electrical connectors to the dash housing, **(1)**.
14. Reattach the dash housing, **(1)**, to the firewall.
15. Reconnect all electrical connectors to the instrument panel, **(2)**, and insert the instrument panel into the dash housing, **(1)**.
16. Reinstall the steering wheel, **(3)**.
17. Reinstall the left-hand, right-hand and center rear hood panels, **(4)**.
18. Reinstall the left-hand and right-hand engine side covers, **(5)**.
19. Reinstall the hood, **(6)**, and reconnect headlight wiring harness, **(7)**.
20. Install the remote loader control valve, and all connecting hydraulic tubes to the right side loader tower.

21. Reconnect the positive (+) battery cable and negative (-) battery cable to the battery, **(8)**.

⚠ WARNING ⚠

Hydraulic oil or diesel fuel leaking under pressure can penetrate the skin and cause infection or other injury. To Prevent Personal Injury: Relieve all pressure, before disconnecting fluid lines or performing work on the hydraulic system. Before applying pressure, make sure all connections are tight and components are in good condition. Never use your hand to check for suspected leaks under pressure. Use a piece of cardboard or wood for this purpose. If injured by leaking fluid, see your doctor immediately. Failure to comply could result in death or serious injury.

M149D

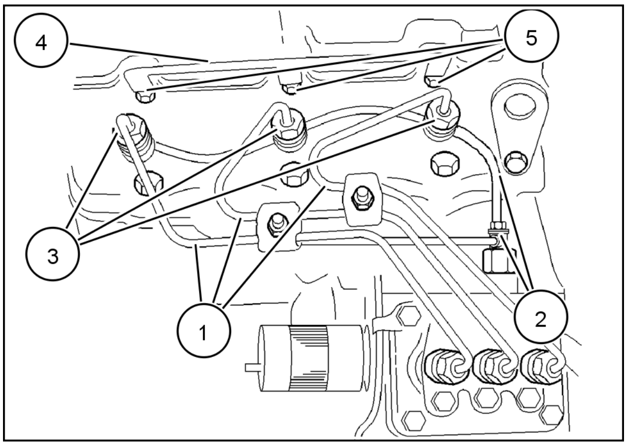
22. Start the tractor and check for leaks.
23. Make any necessary adjustments needed for proper operation of the tractor.

Next operation:
ENGINE - Disassemble (B.10.A).

ENGINE - Disassemble

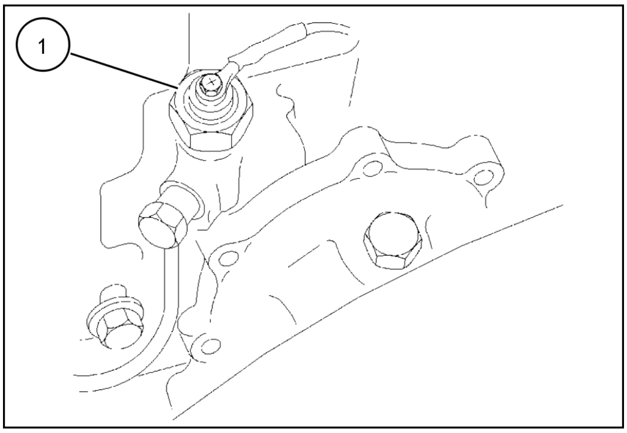
Prior operation:
ENGINE - Remove Separating the tractor at the engine/frame (B.10.A).

1. Fuel Injector and Glow Plug - Removal
    1. Clean all dirt and oil from the injectors and surrounding areas.
    2. Disconnect the fuel lines, **(1)**, from the injectors and cap all openings.
    3. Remove the injector fuel leak-off line, **(2)**.
    4. Remove the injector assemblies, **(3)**.
    5. Remove the glow plug bus connector, **(4)**, and remove the glow plugs, **(5)**.



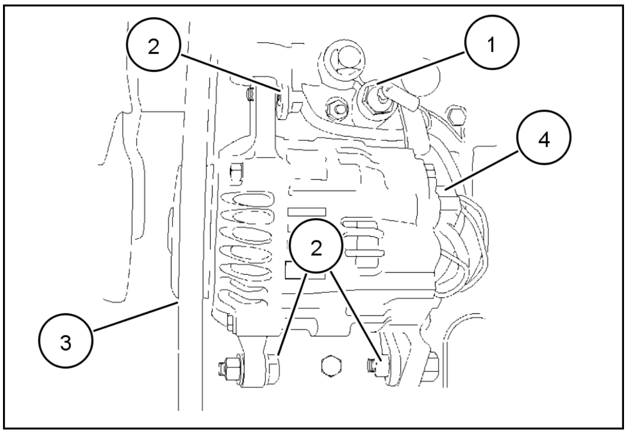
20093359 1

2. Oil Pressure Switch
    1. Remove the oil pressure switch, **(1)**.



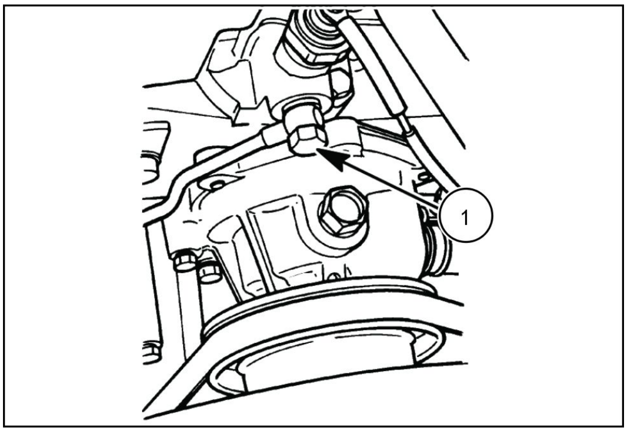
20097780 2

3. Temperature Sending Switch and Alternator
    1. Remove the temperature sending switch, **(1)**, from the front of the cylinder head.
    2. Loosen the alternator mounting bolts, **(2)**, and remove the V-belt, **(3)**, from the drive pulley
    3. Disconnect the alternator wires from the back of alternator, **(4)**.
    4. Remove the alternator mounting bolts, **(2)**, and remove the alternator.



20097781 3

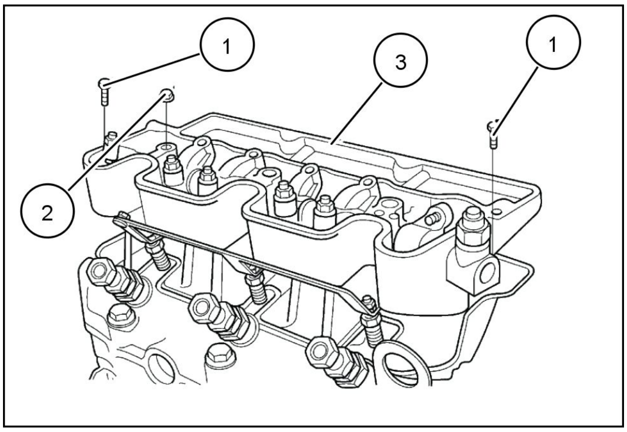
4. Fan, Water Pump, and External Oil Tube - Removal
    1. Remove the fan and water pump assembly. See **Water pump - Remove (B.50.A)**, which includes fan removal also.
    2. Remove the external oil transfer tube banjo bolt, **(1)**, from the front of the cylinder head.



19988040 4

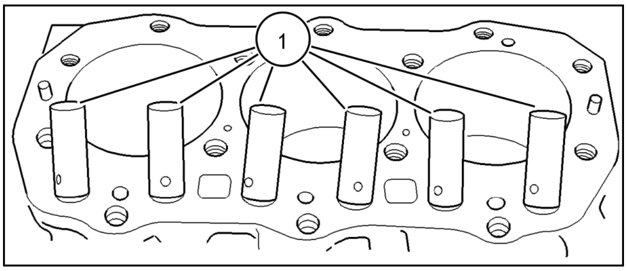
5. **Air intake manifold - Remove (B.30.A)**.
6. Rocker Arm Shaft and Support Bracket - Removal
    1. Remove the bolts, **(1)**, and nuts, **(2)**.
    2. Remove the rocker arm shaft and support bracket as an assembly, **(3)**.

NOTE: *Alternately loosen the rocker support bolts a turn at a time to prevent distorting the rocker shaft.*



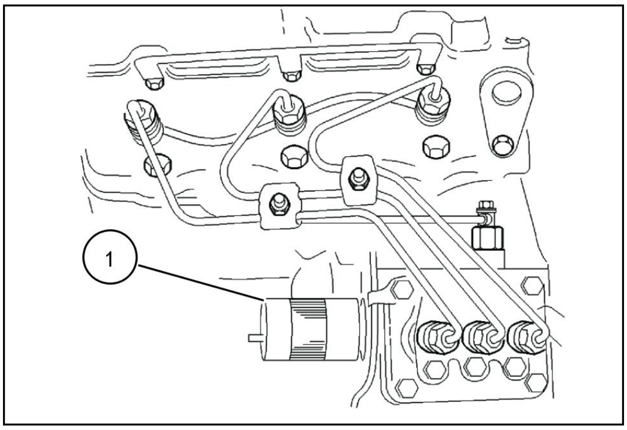
10044354 5

7. **Cylinder head - Remove (B.10.A)**.
8. Valve Tappet - Removal
    - Remove the valve tappets, **(1)**, from the machined bore in the cylinder block.



20093362 6

9. Fuel Shutoff Solenoid - Removal
    - Remove the wire connector and unscrew the fuel shutoff solenoid, **(1)**.



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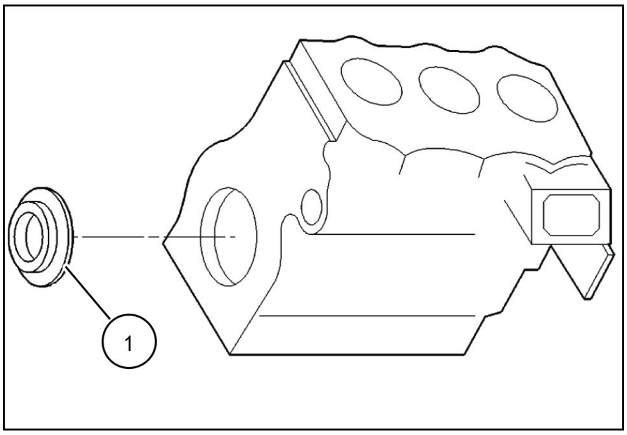
10. **Timing gear housing - Remove (B.10.A)**.
11. **Timing gear - Remove - with camshaft (B.10.A)**.

12. **Oil pan - Remove (B.60.A)**.
13. **Oil pump - Remove - Suction pipe and strainer (B.60.A)**.
14. **Balancer - Remove (B.10.A)**.
15. **Connecting rod and piston - Remove (B.10.A)**.
16. **Flywheel - Remove (B.10.A)**.
17. Backplate and Oil Seal - Removal
    1. Remove the backplate retaining bolts and remove the backplate.
    2. Remove the rear oil seal, **(1)**.



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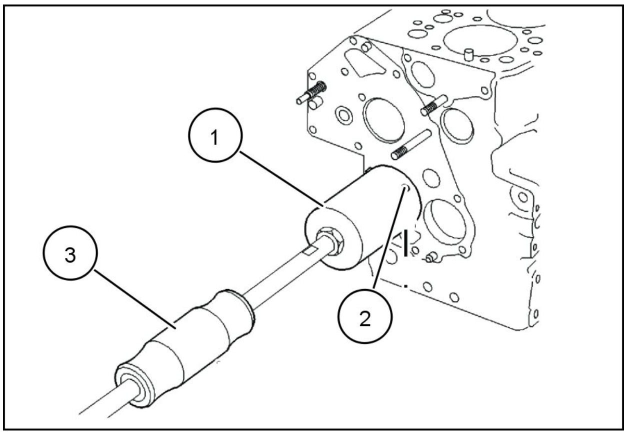
18. **Crankshaft - Remove (B.10.A)**.
19. Port Block - Removal
    1. Using special Tool No. 380002888, **(1)**, place the collars in the grooves of the port block assembly.
    2. Align the set screws, **(2)**, of the puller, **(1)**, with the counter bores in the collars and tighten.
    3. Using a sliding hammer, **(3)**, remove the port block.

NOTE: *The oil pump shaft and port block assembly is a press fit in the block.*

NOTE: *The camshaft gear and the back plate have to be removed from the engine, to provide clearance for the port block removal tool installation.*



SECT10C01PG65_2 9

Next operation:
ENGINE - Inspect (B.10.A).

ENGINE - Inspect

Prior operation:
ENGINE - Disassemble (B.10.A).

1. **Cylinder head - Inspect (B.10.A)**.
2. **Valve drive - Inspect - Valve seats (B.10.A)**.
3. **Valve drive - Inspect - Valves (B.10.A)**.
4. **Valve drive - Inspect - Valve guides (B.10.A)**.
5. **Valve drive - Inspect - Valve springs (B.10.A)**.
6. **Valve drive - Inspect - Rocker arms (B.10.A)**.
7. **Valve drive - Inspect - Push rods (B.10.A)**.
8. **Cylinder block - Inspect (B.10.A)**.
9. **Connecting rod and piston - Inspect - Piston (B.10.A)**.
10. **Connecting rod and piston - Inspect - Piston rings (B.10.A)**.
11. **Connecting rod and piston - Inspect - Connecting rod (B.10.A)**.
12. **Connecting rod and piston - Inspect - Connecting rod bearing (B.10.A)**.
13. **Crankshaft - Inspect Main bearing and thrust washer (B.10.A)**.
14. **Crankshaft - Inspect (B.10.A)**.
15. **Crankshaft - Inspect Bearing/Bushing (B.10.A)**.
16. **Timing gear - Inspect (B.10.A)**.
17. **Timing gear - Inspect Camshaft (B.10.A)**.
18. **Flywheel - Inspect (B.10.A)**.
19. **Timing gear housing - Inspect (B.10.A)**.

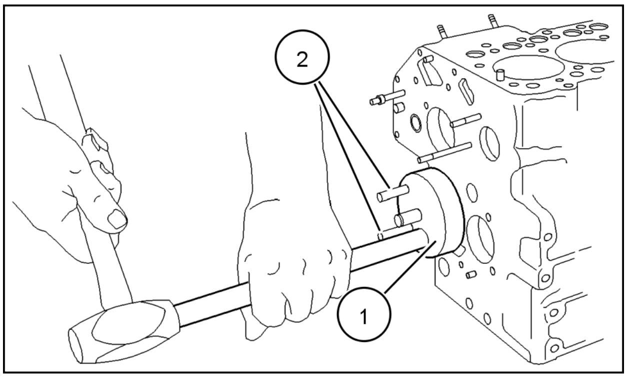
Next operation:
ENGINE - Assemble (B.10.A).

ENGINE - Assemble

Prior operation:
ENGINE - Inspect (B.10.A).

1. Port Block Installation
    1. Using special Tool No. 380002887, **(1)**, insert the threaded guide pins, **(2)**, into the cylinder block.
    2. Assemble the oil pump shaft to the port block using nut and washer.
    3. Insert the port block assembly into the installer and place on the guide pins.
    4. Using a suitable driver, install the port block assembly. The installer must bottom against the engine block when fully positioned.

***NOTE:** Plate, **(3)**, must be removed from engine block for proper installation of the port block.*



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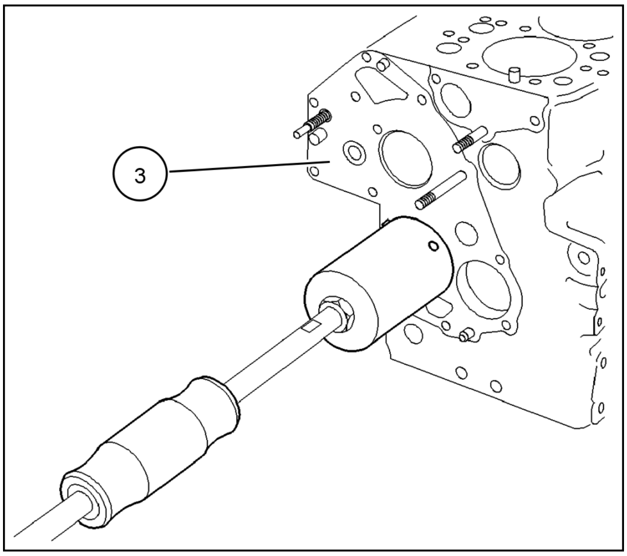
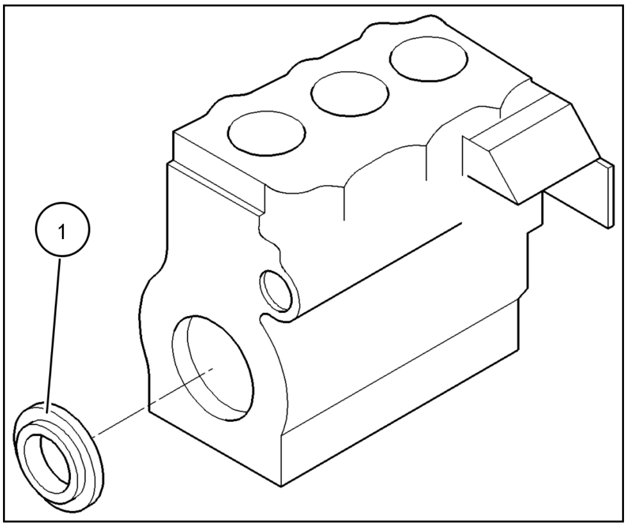


20093398 2

2. **Crankshaft - Install with bearing holder (B.10.A)**.
3. Rear Oil Seal and Backplate
    1. Install the rear oil seal, **(1)**, over the rear of the crankshaft.
    2. Apply liquid gasket sealer to the backplate attaching bolts, install the back and tighten the back plate bolts to **14 - 18 N·m** (**10 - 13 lb ft**).

***NOTE:** The rear oil seal is a press fit retained by the backplate.*

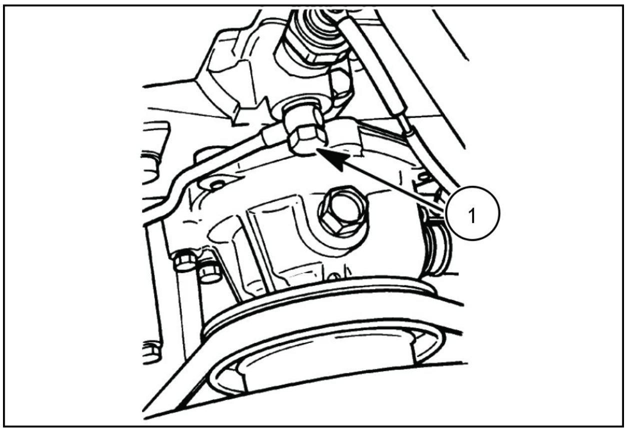


20093406A 3

4. **Flywheel - Install (B.10.A)**.

5. **Connecting rod and piston - Install (B.10.A)**.
6. **Balancer - Install (B.10.A)**.
7. **Oil pump - Install Oil suction pipe and suction strainer (B.60.A)**.
8. **Oil pan - Install (B.60.A)**.
9. **Timing gear - Install Camshaft and gear (B.10.A)**.
10. **Timing gear - Install Idler gear, Oil pump, and Injection timing (B.10.A)**.
11. **Timing gear housing - Install (B.10.A)**.
12. **Crankshaft - Install Pulley (B.10.A)**.
13. **Fuel injection pump - Install (B.20.A)**.
14. **Hydraulic pump - Install Engine mounted (A.14.A)**.
15. **Cylinder head - Replace Gasket (B.10.A)**.
16. **Cylinder head - Install (B.10.A)**.
17. **Valve drive - Clearance Valves (B.10.A)**.
18. **Valve cover - Install (B.10.A)**.
19. **Water pump - Install with cooling fan (B.50.A)**.
20. External Oil Tube - Assemble
    - Connect the external oil tube to the rocker arm and on side of engine block. Tighten the banjo bolt **(1)**, to **10 - 13 N·m** (**7 - 9 lb ft**).

NOTE: *The banjo bolt has oil port holes drilled in it. Do not use a standard bolt in its place.*



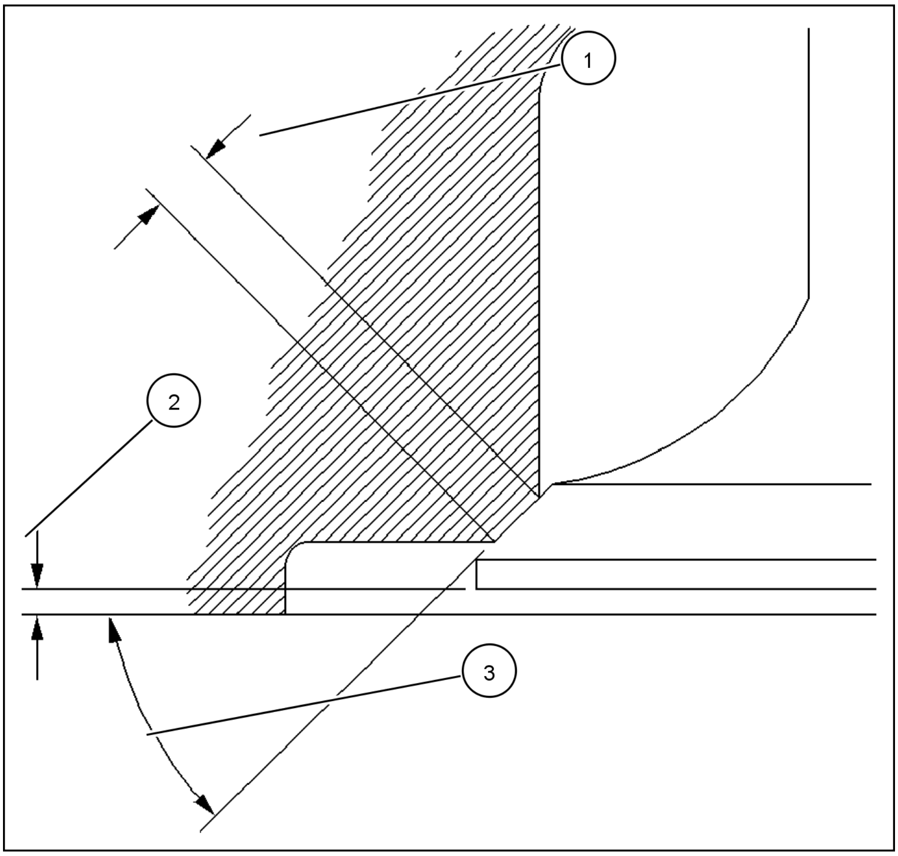
19988040A 4

21. **Cold start aid - Install Glow plug and connector (B.80.A)**.
22. **Fuel injector - Install (B.20.A)**.
23. **Alternator - Install (A.30.A)**.
24. **Exhaust manifold - Install (B.40.A)**.

Valve drive - Inspect - Valve seats

Examine the valve seats and surface the seat if damaged. Valve seat grinding requires that the seat be ground to the correct width and properly positioned. A valve that extends too deep into the combustion area will result in valve burning. If the valve is recessed too deep into the head it will cause a rapid build-up of carbon deposits.

Prior operation:
Cylinder head - Inspect (B.10.A).

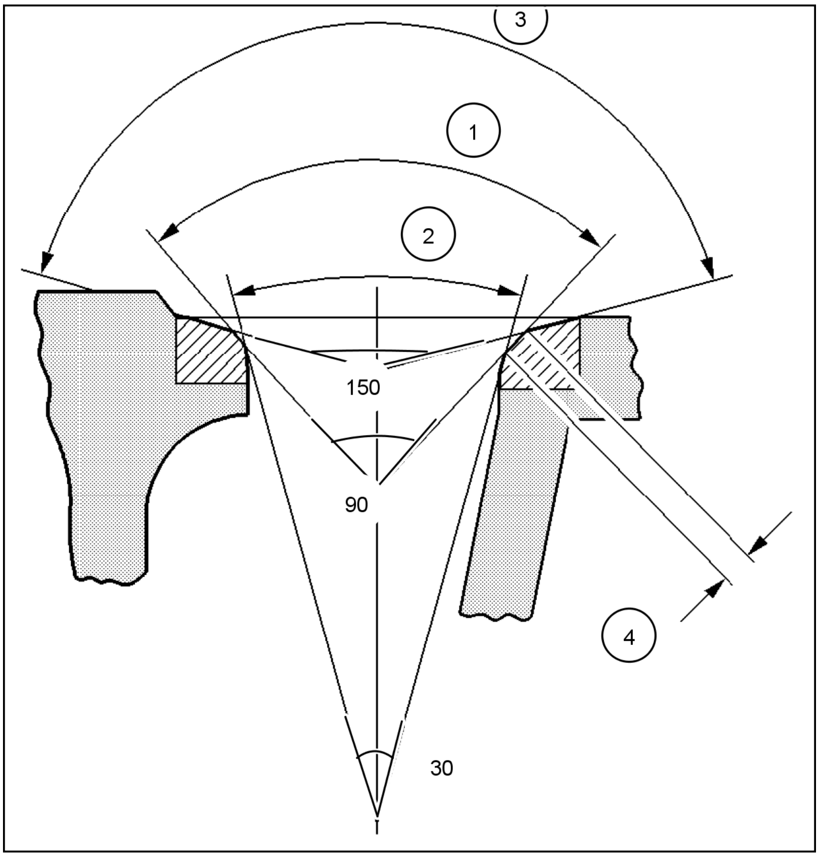


20093372 1

(1) Correct Valve Seat Width and Location.
(2) Correct Valve Head Margin ISM N843 0.7 - 1.0 mm (0.027 - 0.039 in)
(3) 45 ° Valve Seat Angle

1. Check the seat for surface defects. Use a **45 °** stone if necessary to reface. Grind away only enough material to provide a smooth even seat.
2. Check the seat width. If necessary, use a **15 °** stone to lower the seat contact point and use a **75 °** stone to raise the seat contact point.

NOTE: *Refacing the seat should always be coordinated with refacing of the valve to ensure a compression tight fit.*



20093373 2

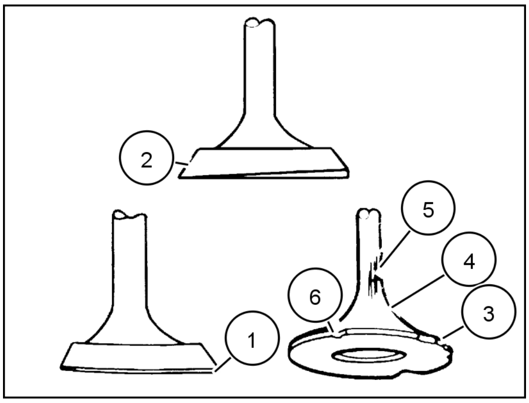
(1) Seat angle - 45 ° Stone
(2) Lower Seat Location - 15 ° Stone
(3) Raise Seat Location - 75 ° Stone
(4) 0.5 mm (0.020 in).

Next operation:
Valve drive - Inspect - Valves (B.10.A).

Valve drive - Inspect - Valves

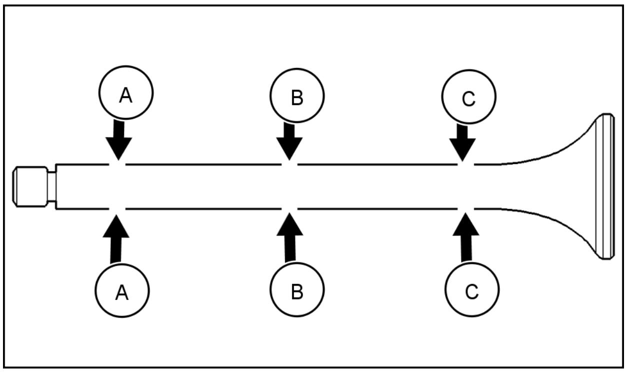
Clean all deposits from the valves using a soft wire brush. Inspect the condition of the valves and discard any that are badly burned, cracked, or bent.

Prior operation:
Valve drive - Inspect - Valve seats (B.10.A).



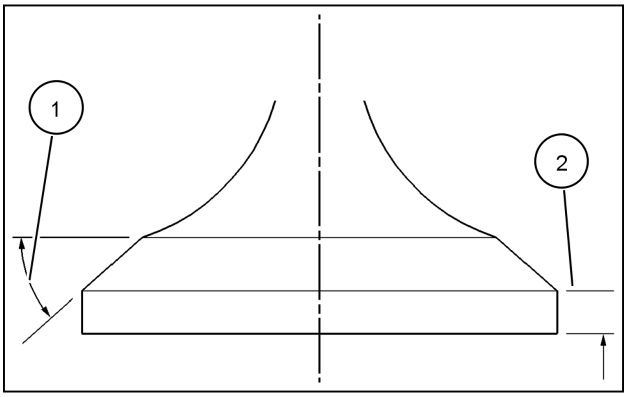
20093374 1

1. Using a micrometer, measure the valve stem at points **(A)**, **(B)**, and **(C)**.



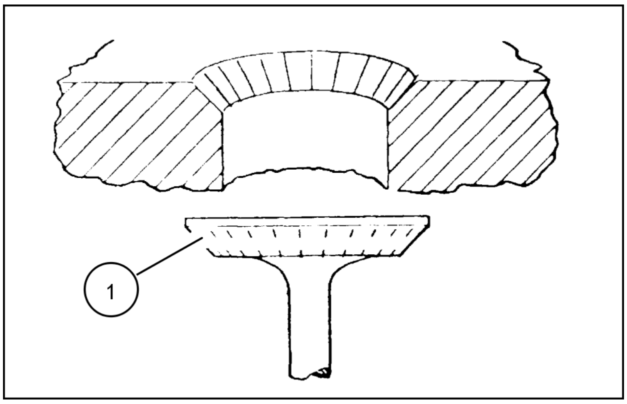
20093375A 2

2. If inspection indicates that the valve may be reused, the valve should be ground:
   (1) 45 ° Angle Seat
   (2) Minimum Valve Margin
3. After grinding the valve and seat, check to ensure the seat contacts the center of the valve face. Using Prussian Blue, lightly coat the valve seat, place the valve in position and rotate the valve slightly while holding a light pressure against the valve. If the blue is transferred to the center of the valve face, the contact is correct.



20093376 3

4. If Prussian Blue is not available, mark the valve face or seat **(1)**, with a soft lead pencil. Rotate the valve slightly in the seat. The penciled lines will be broken at the seat contact area.



20093377 4

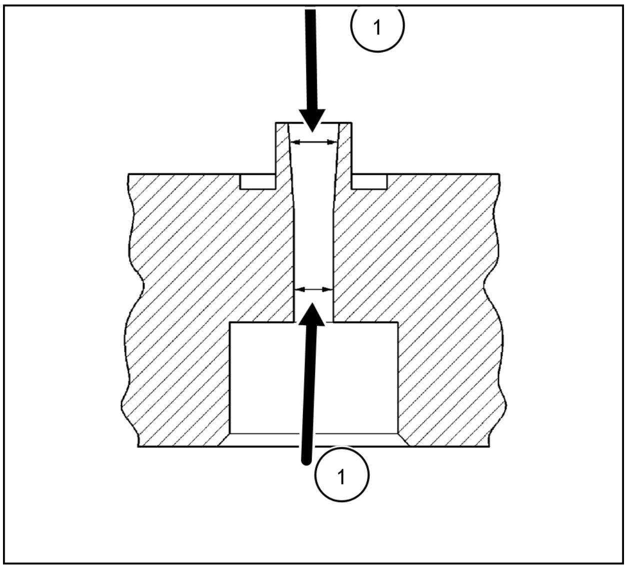
Next operation:
Valve drive - Inspect - Valve guides (B.10.A).

Valve drive - Inspect - Valve guides

Thoroughly clean the valve guides before attempting to check internal wear.

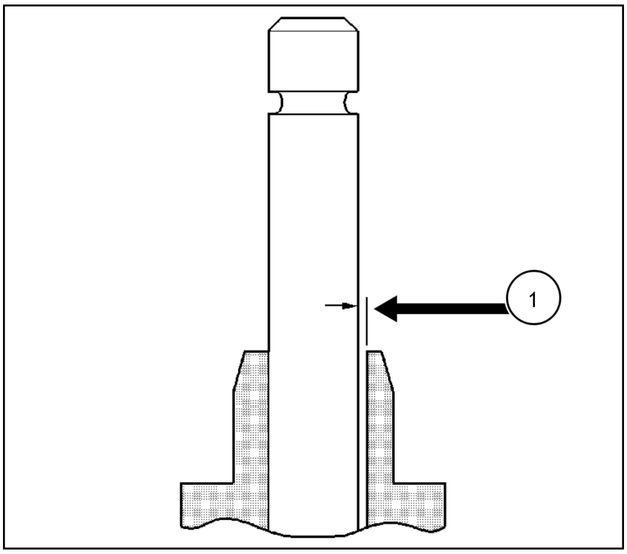
Prior operation:
Valve drive - Inspect - Valves (B.10.A).

1. Using a telescoping gauge and micrometer, measure the valve guide bore at the top and bottom wear points **(1)**.



20093378A 1

2. Determine the valve stem to valve guide clearance **(1)**, by subtracting the valve stem diameter from the valve guide diameter. Replace valves if the clearance **(1)**, is more than **0.2 mm** (**0.008 in**), intake valves, or **0.25 mm** (**0.010 in**), exhaust valves.
3. Replace the cylinder head if excessive clearance is determined and the valves have met all specified measurement requirements. See "Specifications" in **Cylinder head - Dimension (B.10.A)**.

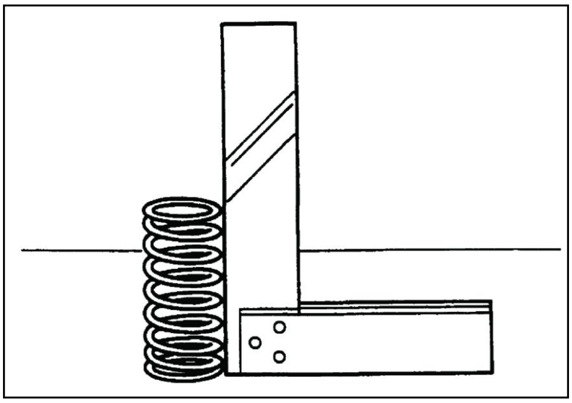


20093379A 2

Next operation:
Valve drive - Inspect - Valve springs (B.10.A).

Valve drive - Inspect - Valve springs

Prior operation:
Valve drive - Inspect - Valve guides (B.10.A).



SECT10C01P52_1 1

1. Place the valve springs on a flat surface. Measure the free length of the spring and squareness. Replace springs that do not meet the following specifications (all models):

Max Out of Square	Min. Free-Length
2.0 mm (**0.079 in**)	**33.5 mm** (**1.319 in**)

2. Place the springs in a suitable spring load tester and measure the spring load rating. Replace springs that do not meet the following specifications (all models):

Standard	Maximum
8.1 kg (**17.86 lb**) at **30.4 mm** (**1.197 in**)	**7 kg** (**15.43 lb**) at **30.4 mm** (**1.197 in**)

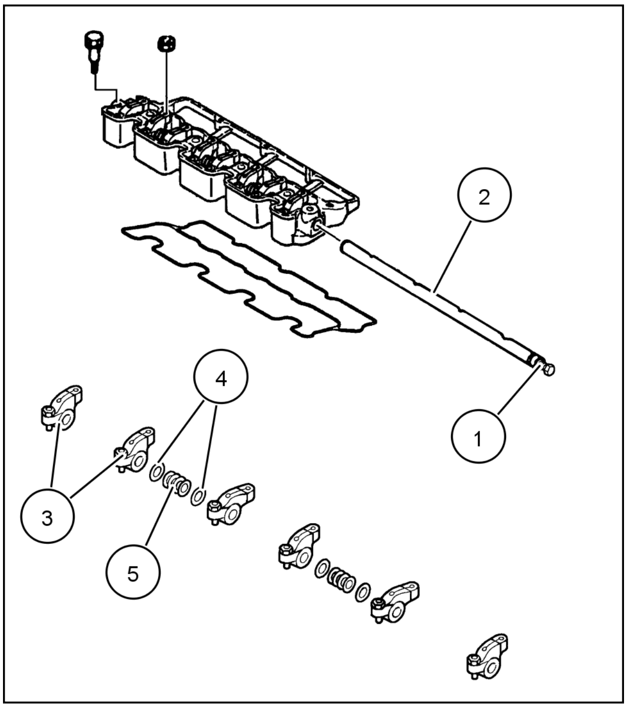
Next operation:
Valve drive - Inspect - Rocker arms (B.10.A).

Valve drive - Inspect - Rocker arms

Prior operation:
Valve drive - Inspect - Valve springs (B.10.A).

1. Thread an **8 mm** bolt, **(1)**, into the rear end of the rocker shaft, **(2)**, and slowly withdraw the rocker shaft while at the same time removing the rocker arms and springs.
2. Inspect the rocker arms, **(3)**, and shaft for wear or damage. Check the adjusting screws for damaged threads or excessive wear.
3. Check the valve stem contact area for pitting or excessive wear. Slight wear patterns may be removed using a fine grit oil stone.

NOTE: *The rocker shaft housing must be removed from the cylinder head, before rocker shaft can be removed from housing. Housing mounting bolts retain rocker shaft.*



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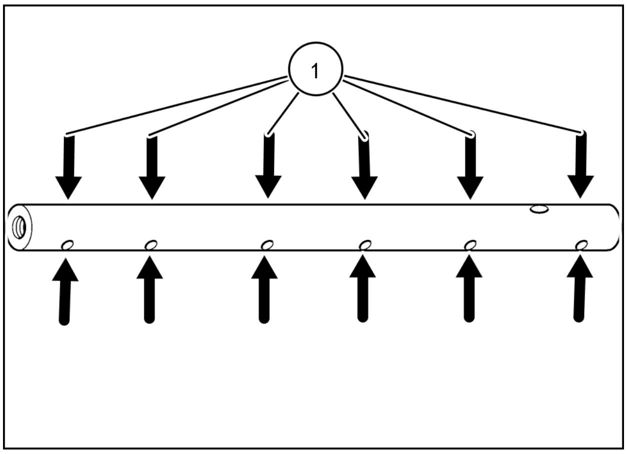
(1) **8 mm** Bolt
(2) Rocker Arm Shaft
(3) Rocker Arm
(4) Shims
(5) Spring

4. Using an outside micrometer, measure the wear points, **(1)**, on the rocker shaft. Replace the rocker shaft if the wear at any point exceeds **0.2 mm** (**0.008 in**).

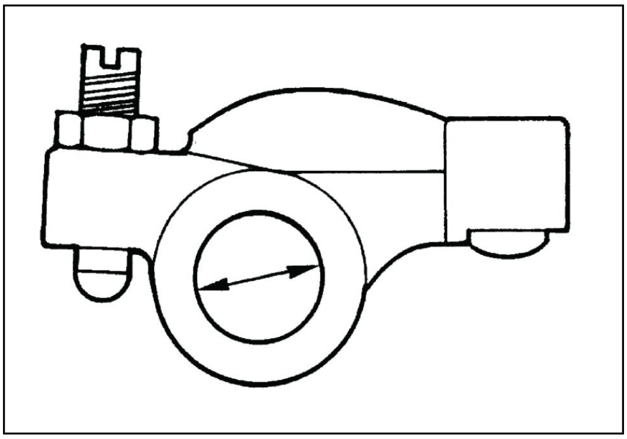
NOTE: *Lube holes, one set on bottom of rocker shaft at* ***170 °****from the oil pressure check hole.*



10044358A 2

5. Using a telescoping gauge and micrometer, measure the inside of the rocker arm. Replace rocker arms having a bore diameter exceeding **14.87 mm** (**0.584 in**). Replace the rocker shaft and/or rocker arm if the rocker arm to shaft clearance exceeds **0.2 mm** (**0.008 in**).

NOTE: *Rocker arms have no bushings and only one lube hole.*



20002375 3

Next operation:
Valve drive - Inspect - Push rods (B.10.A).

Valve drive - Inspect - Push rods

Prior operation:
Valve drive - Inspect - Rocker arms (B.10.A).

1. Check the push rods for straightness by rolling on a flat surface. Replace rods that are bent.
2. Inspect the ends of the push rods for excessive wear. If any push rod is worn, the corresponding lifter and rocker arm should also be inspected for excessive wear.

Next operation:
Cylinder head - Assemble (B.10.A).

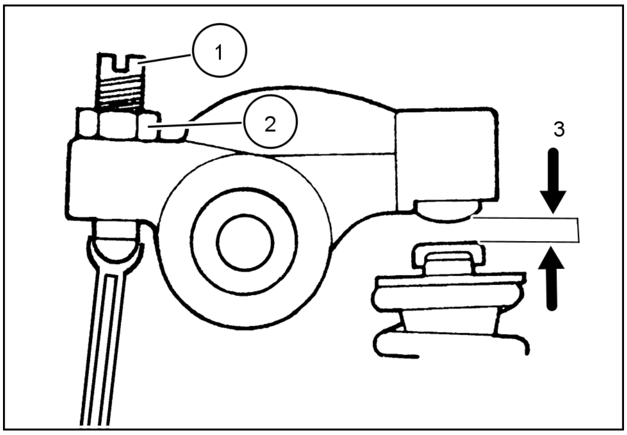
Valve drive - Clearance Valves

Prior operation:
Cylinder head - Install (B.10.A).

NOTE: *The prior operation procedure refers to engine overhaul.*

Adjustment

1. Adjust the rocker arm to valve clearance. Be sure the tappet is in its lowest position before making the adjustment. To be sure the tappet is in its lowest position, bring the piston to top dead center on the compression stroke (both valves closed).
2. Loosen the nut and adjust the clearance of both the intake and exhaust valves to **0.2 mm** (**0.008 in**) with the adjusting screw.



76075742 1

(1) Adjusting Screw
(2) Locknut
(3) Valve Clearance **0.2 mm** (**0.008 in**)

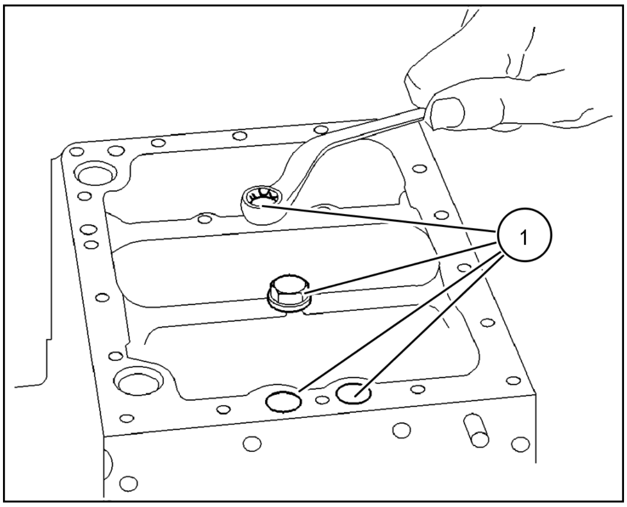
Next operation:
Valve cover - Install (B.10.A).

Crankshaft - Remove

Prior operation:
Backplate and Oil Seal - Remove; See: **ENGINE - Disassemble (B.10.A)**.

NOTE: *The prior operation and next operation procedures refer to engine overhaul.*

1. Remove the crankshaft bearing holder retaining bolts, **(1)**.
2. Slide the crankshaft and main bearing assembly through the rear of the engine.



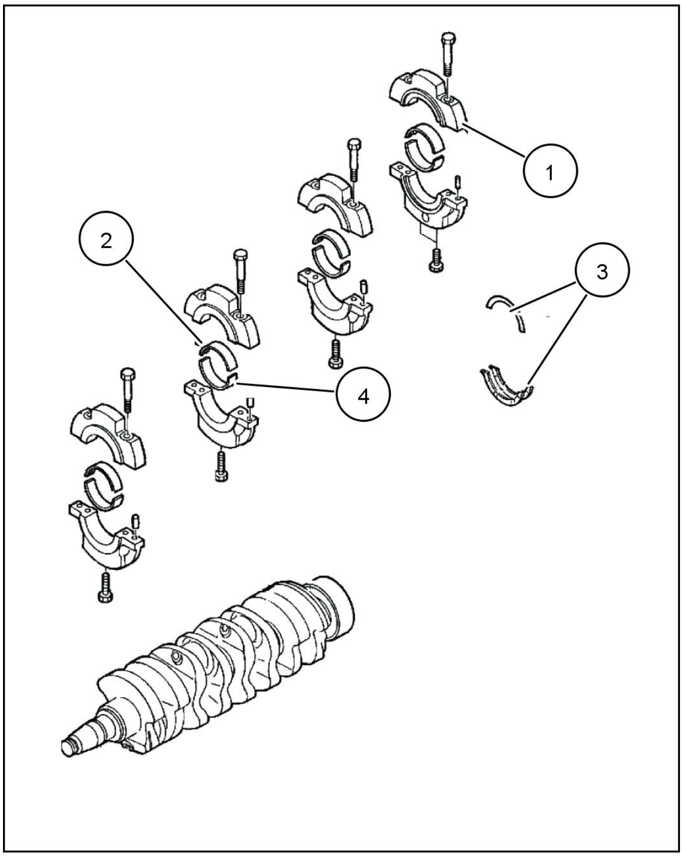
20093368A 1

Next operation:
Port Block - Remove; See: **ENGINE - Disassemble (B.10.A)**.

Crankshaft - Inspect Main bearing and thrust washer

Prior operation:
Crankshaft - Remove (B.10.A)

Removal and Inspection



20044366 1

(1) Holder
(2) Upper Main Liner (with oil groove)
(3) Thrust Bearing
(4) Lower Main Liner (no oil groove)

1. Remove the two retaining bolts from the bearing holders, **(1)**.
2. Remove the bearing holders and bearing liners, **(2)**.
3. Position a piece of plastigauge across the full width of the bearing liners.
4. Install the bearing holder and tighten the bolts to **49.0 - 53.9 N·m** (**36.2 - 39.8 lb ft**).

NOTE: *Do not permit the bearing holder to rotate, even the slightest amount.*

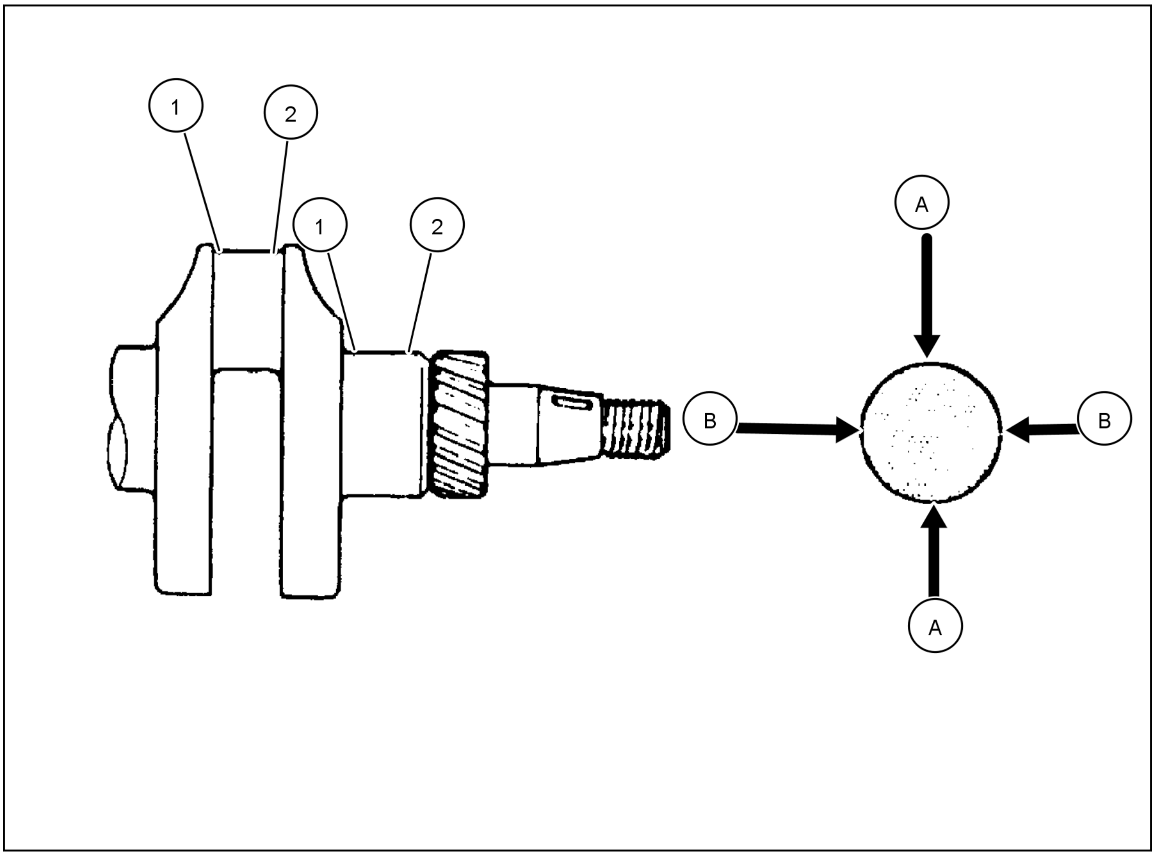
5. Remove the bearing holders and measure the width of the flattened plastigauge using the gauge printed on the plastigauge package.
6. Replace components or grind the crankshaft to the next undersize bearing as required to obtain the correct clearance. See "Specifications".

7. Check the thrust washer for wear, poor contact, burning, or other defects. Using a micrometer measure the washer thickness. If washer thickness is not within allowable limits or found to be defective, the washers must be replaced.
    - Standard Thickness: **2.95 - 3.0 mm** (**0.116 - 0.118 in**).
    - Allowable Limit: **2.8 mm** (**0.11 in**).

Next operation:
Crankshaft - Inspect (B.10.A).

Crankshaft - Inspect

Prior operation:
Crankshaft - Inspect Main bearing and thrust washer (B.10.A).



20093394A 1

(A) Taper Readings: 1 vs. 2
(B) Out-of-Round Readings: A vs. B

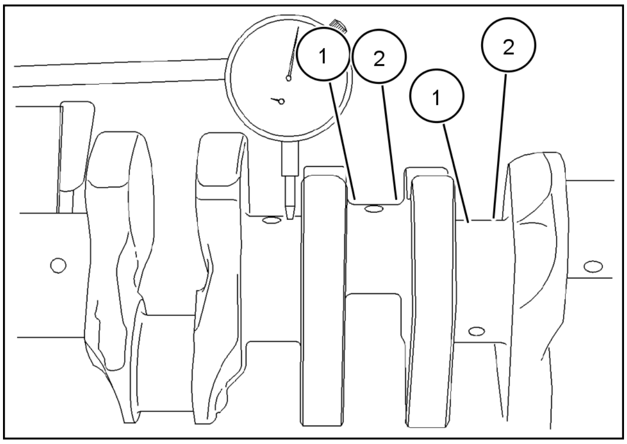
1. Inspect the crankshaft gear teeth for wear or damage and replace if necessary.

2. Using a dial indicator, measure the crankshaft journals for size, runout, and taper.
3. The amount of taper in a journal is the difference in the measurements taken at points **(1)** and **(2)** on a journal.
4. The amount of out-of-round in a journal is the difference in the measurements taken at **90 °** points on the journal.

NOTE: *The smallest reading taken at any one of the readings indicates the size of the journal. See "Specifications" in* ***Crankshaft - Dimension (B.10.A)*** *for wear limits and repair recommendations.*

NOTE: *Undersize bearings are available in* ***0.25 - 0.50 mm*** *(****0.010 - 0.020 in****) for both main and crankpin journals. See "Specifications" in* ***Crankshaft - Dimension (B.10.A)*** *for wear limits and bearing usage.*

5. Mount the crankshaft in a set of V-blocks and measure the amount of runout using a dial indicator.
6. Straighten or replace crankshafts that exceed runout specifications. See "Specifications" in **Crankshaft - Dimension (B.10.A)**.



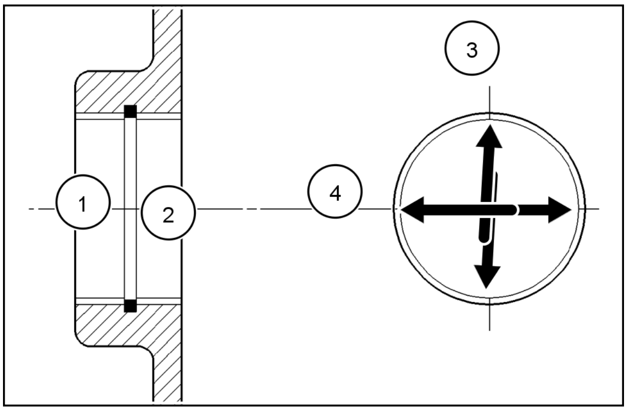
20093395 2

Next operation:
Crankshaft - Inspect Bearing/Bushing (B.10.A).

Crankshaft - Inspect Bearing/Bushing

Prior operation:
Crankshaft - Inspect (B.10.A).

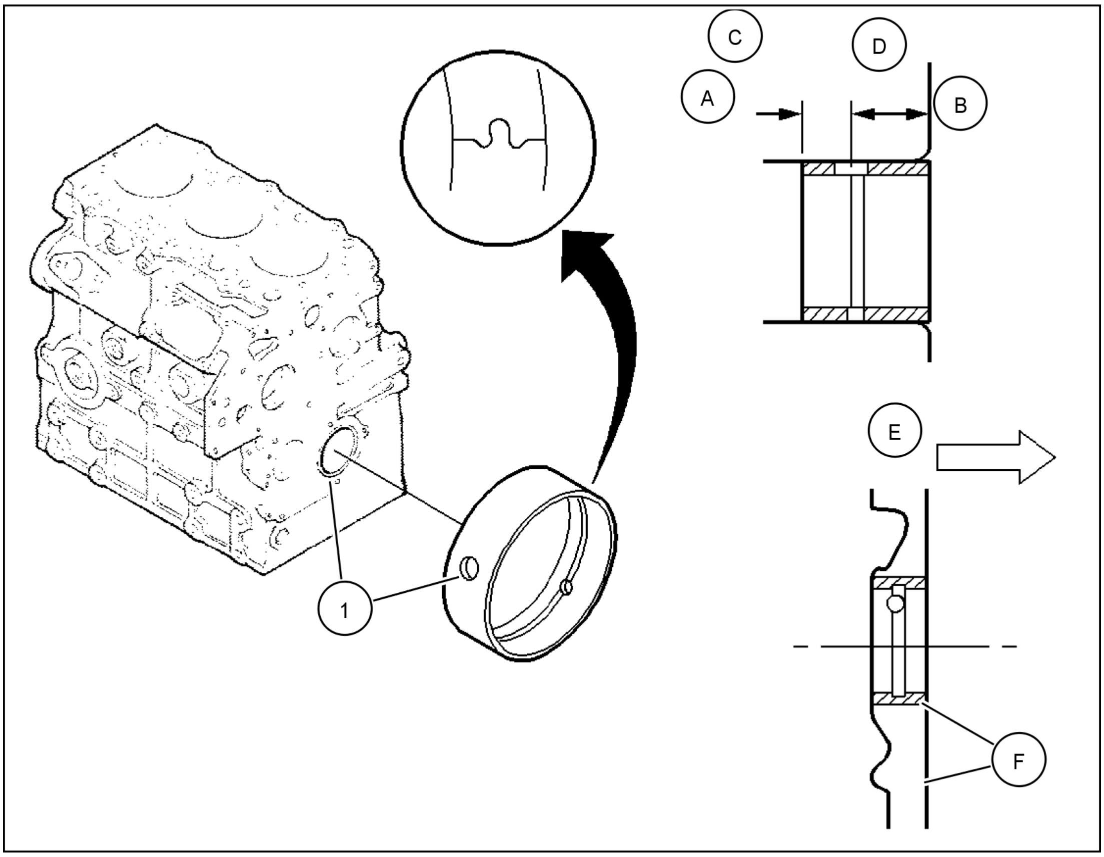
1. Check the bearing (bushing) for peeling, melting, seizure, or poor contact.
2. Using a telescoping gauge and micrometer, measure the oil clearance between the bearing (bushing) and the crankshaft journal.
3. Measure the inside diameters at positions **(1)**and **(2)**. At each position, measure in both directions **(3)** and **(4)**. The oil clearance can be obtained by subtracting this value from the maximum crankshaft journal diameter.



20093396 1

4. If the oil clearance exceeds **0.2 mm** (**0.0078 in**) replace the bearing (bushing) or grind the crankshaft journal. In this case, use an undersized bearing (bushing).

Replacement



20093397 2

Dimensions:
(A) 12.5 mm
(B) 15 mm

Identification:
(C) Clinch
(D) Cylinder Block
(E) Front Side
(F) Align

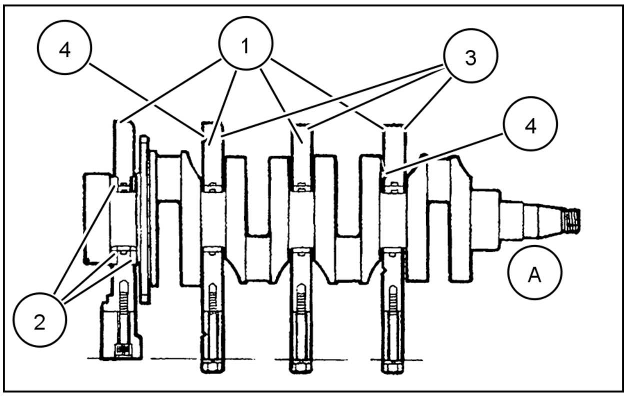
5. Remove the bearing from the front of the cylinder block housing using a bushing driving tool to prevent damage.
6. Inspect the bushing housing for marks, scratches, or damage.
7. The bushing should be smoothly pressed into the correct depth by using a bushing driving tool, aligning the oil hole, and direction of bushing.
   - Press the bushing into the cylinder block from the engine front side.
     - Do not press the bushing into the cylinder block from the opposite side.
     - The correct pressing side is chamfered, etc., to allow smooth operation.
   - Lubricate the outer surface of the bushing.
   - Align the oil hole **(1)**, of the housing and bushing.
   - Press the bushing into the housing until the correct depth by using a bushing driving tool.
8. Confirm the housing and bushing oil holes are in alignment.

Next operation:
Crankshaft - Assemble Main bearing (B.10.A).

Crankshaft - Assemble Main bearing

Prior operation:
Crankshaft - Inspect Bearing/Bushing (B.10.A).

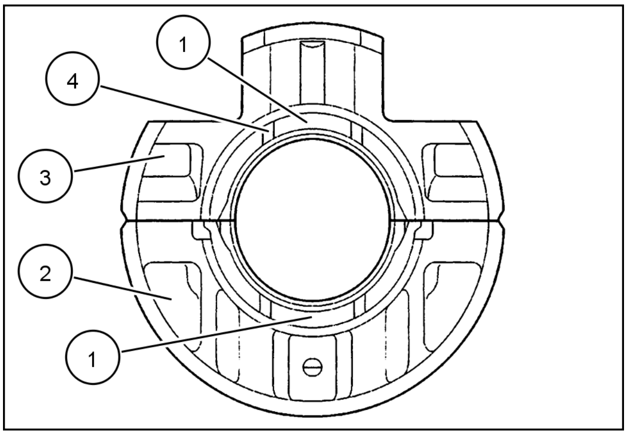
1. Install the bearing holders, **(1)**, along with their liners. The rear bearing is also assembled along with the thrust bearing halves, one located on each side of the bearing. Be sure the bearing holders are correctly positioned on the shaft with the chamfered edge facing forward.
2. Torque the bearing holder retaining bolts to **49.0 - 53.9 N·m** (**36.2 - 39.8 lb ft**).



76074367B 1

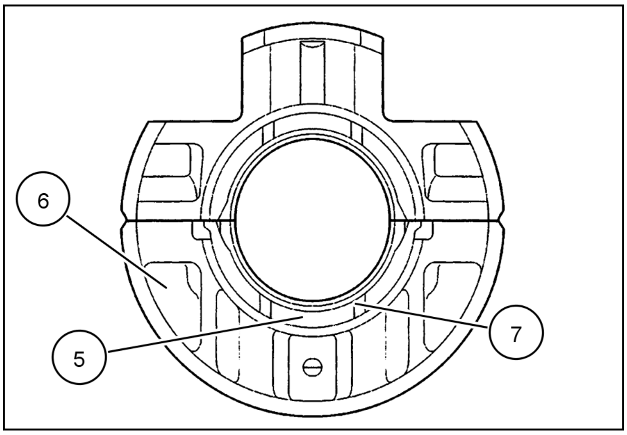
(1) Bearing Holders
(2) Thrust Bearing
(3) Lead Chamfer (forward)
(4) Holder Location Identification Mark
(A) Front

NOTE: *Be sure to install thrust bearings, **(1)**, on the rear side of the lower, **(2)**, and upper, **(3)**, bearing holders. Position thrust bearings with oil grooves, **(4)**, facing outward from bearing holders.*



76075741 2

NOTE: *Be sure to install thrust bearing, **(5)**, on the front side of the lower bearing holder, **(6)**. Position thrust bearing with oil grooves, **(7)**, facing outward from bearing holder.*



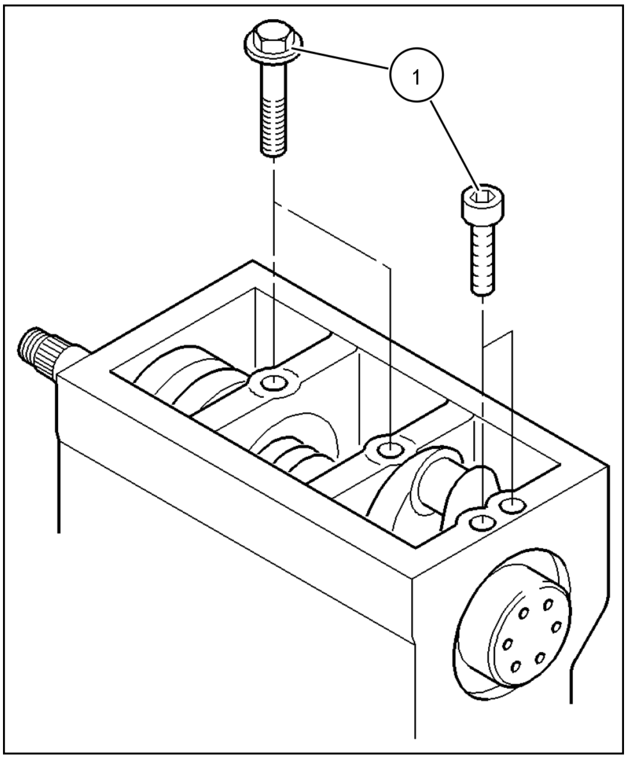
76075741A 3

Next operation:
Crankshaft - Install with bearing holder (B.10.A)

Crankshaft - Install with bearing holder

Prior operation:
Crankshaft - Assemble Main bearing (B.10.A)

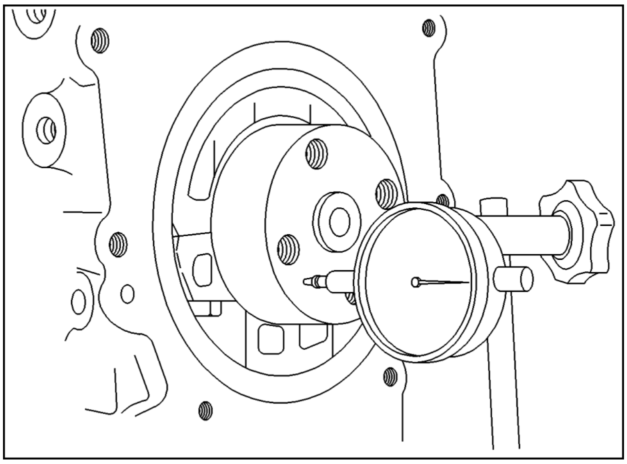
1. Install the crankshaft with bearing holder through the rear of the cylinder block.
2. Align the threaded holes on the bearing holders with the bolt holes in the cylinder block.
3. At the flywheel end install the socket head hex bolts, at each center bearing install the hex head bolt. Torque the socket head bolts to **24 - 31 N·m** (**18 - 22 lb ft**). Torque the hex head bolts to **49 - 54 N·m** (**36 - 40 lb ft**).



20093404 1

(1) Bearing Holder Bolts

4. Using a dial indicator, measure the crankshaft end float (thrust). If the thrust is not within the allowable limit, remove the crankshaft and check the thrust washers.
   - Standard Thrust: **0.1 - 0.4 mm** (**0.0039 - 0.0156 in**).
   - Allowable Limit: **0.5 mm** (**0.0195 in**).



20093405 2

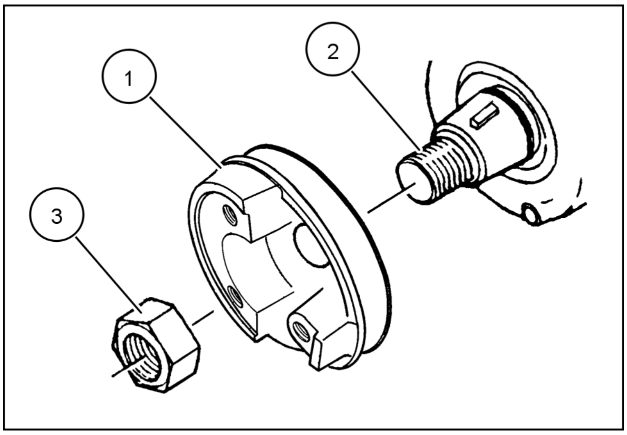
Next operation:
Rear oil seal and back plate install, Refer to: **ENGINE - Assemble (B.10.A)**

Crankshaft - Install Pulley

Prior operation:
Timing gear housing - Install (B.10.A).

NOTE: *The prior operation and next operation procedures refer to engine overhaul.*

1. Align the keyway on the crankshaft pulley, **(1)**, and the crankshaft, **(2)**. Push the pulley onto the shaft.
2. Install the retaining nut, **(3)**, and torque to **274.4 - 333.2 N·m** (**202.5 - 245.9 lb ft**).



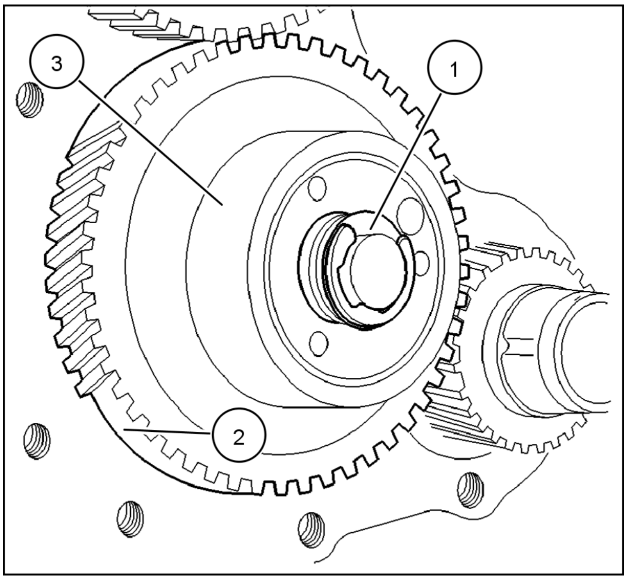
76075736A 1

Next operation:
Fuel injection pump - Install (B.20.A).

Timing gear - Remove - with camshaft

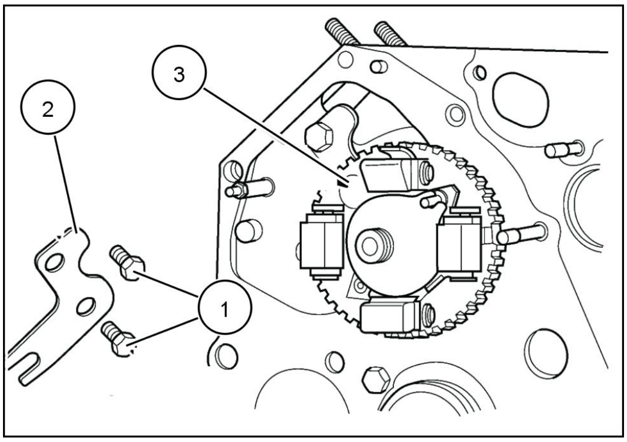
Prior operation:
Timing gear housing - Remove (B.10.A).
Prior operation:
Timing gear - Inspect (B.10.A)

1. Remove retaining ring, **(1)**, and remove the idler gear, **(2)**, and oil pump assembly, **(3)**, with shims and spring.



20093365 1

2. Remove the bolts, **(1)**, securing the keeper plate, **(2)**. One must be accessed using the access hole, **(3)**, in the cam gear.
3. Slide the camshaft and gear out of the camshaft bore.



SECT10C01PG45_1 2

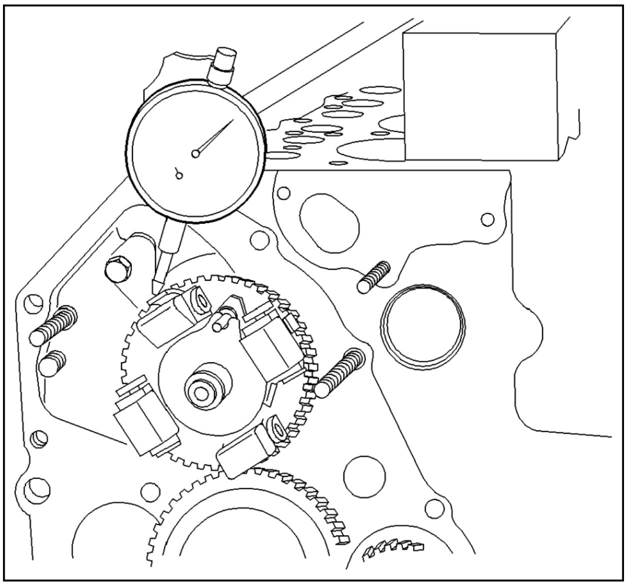
NOTE: *The next operation (Oil pan - Remove) procedure refers to engine overhaul.*

Next operation:
Oil pan - Remove (B.60.A).
Next operation:
Timing gear - Inspect Camshaft (B.10.A)

Timing gear - Inspect

Prior operation:
Timing gear housing - Remove (B.10.A).

1. Check the timing gears for wear and damage on the contact area. Replace if any defect is found.
2. Measure the backlash of gears with a feeler gauge or dial indicator. If the allowable limit is exceeded, replace all timing gears.



20093400 1

Standard	Allowable Limit
0.08 mm (**0.003 in**)	**0.25 mm** (**0.010 in**)

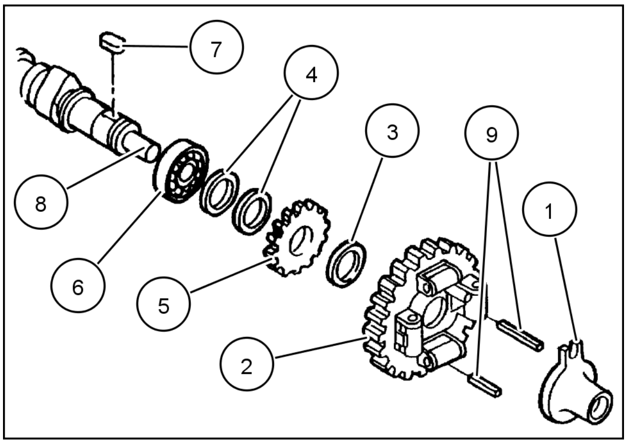
Next operation:
Timing gear - Remove - with camshaft (B.10.A)

Timing gear - Inspect Camshaft

Prior operation:
Timing gear - Remove - with camshaft (B.10.A).

Disassembly

1. Remove the slider, **(1)**, from the camshaft gear.
2. Using a gear puller, remove the gear assembly, **(2)**, spacer, **(3)**, spacers, **(4)**, spacer gear, **(5)**, bearing, **(6)**, and key, **(7)**, from the camshaft, **(8)**.

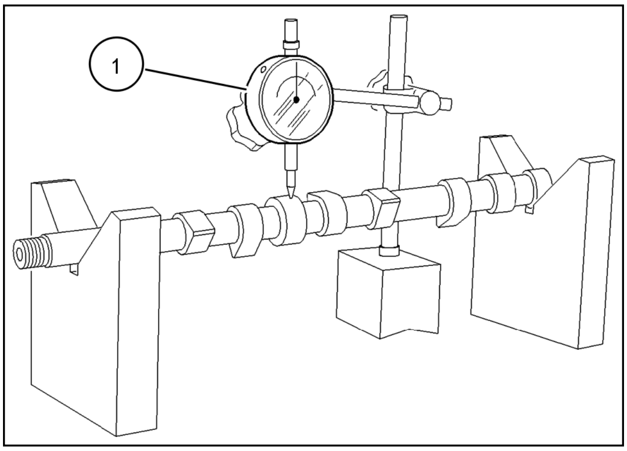


20093401 1

Inspection

3. Place the camshaft in a set of V-blocks and check the runout using a dial indicator, **(1)**.
4. Replace or straighten the camshaft if the runout is greater than **0.1 mm** (**0.004 in**).
5. Using a micrometer, measure the height of the camshaft lobes.
6. Replace the camshaft if any of the cam lobes are worn to less than the following dimensions:

   Valve Lobe: **34.1 mm** (**1.3425 in**)
   Injection Pump Lobe: **42.8 mm** (**1.685 in**).



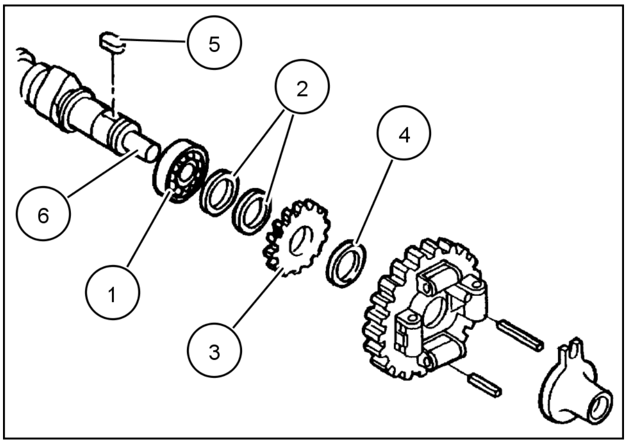
20093402 2

Assembly

7. Install bearing, **(1)**, two spacers, **(2)**, spacer gear, **(3)**, and spacer, **(4)**.

NOTE: *The spacer gear, **(3)**, serves as a spacer only. There is no other purpose for this gear.*

8. Insert key, **(5)**, into key slot on shaft and press the gear assembly over the shaft onto the key.
9. Install the slider, **(5)** back onto the gear assembly, **(6)**.



20093401A 3

NOTE: *The next operation (Flywheel - Inspect) procedure refers to engine overhaul.*

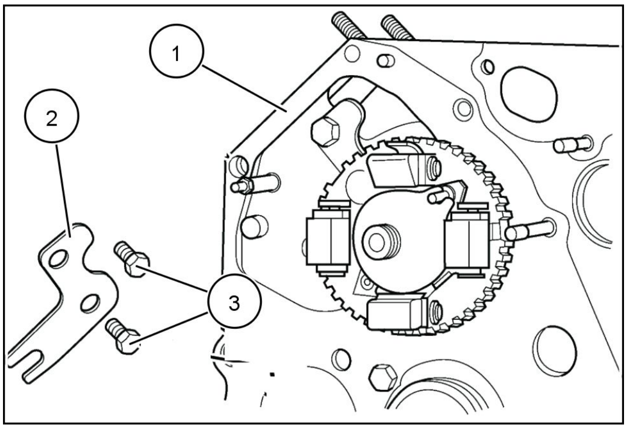
Next operation:
Flywheel - Inspect (B.10.A)
Next operation:
Timing gear - Install Camshaft and gear (B.10.A).

Timing gear - Install Camshaft and gear

Prior operation:
Oil pan - Install (B.60.A).

NOTE: *The prior operation procedure refers to engine overhaul.*

1. Install the front plate, **(1)**, and gasket on the mounting dowels and tighten the retaining bolts.
2. Carefully insert the camshaft into its bore so as not to damage the bearings or bearing surfaces.
3. Align the retaining plate, **(2)**, to the block bolt holes, and install the retaining bolts, **(3)**. Tighten the bolts to **8.8 - 12.9 N·m** (**6.5 - 9.5 lb ft**).



10044355B 1

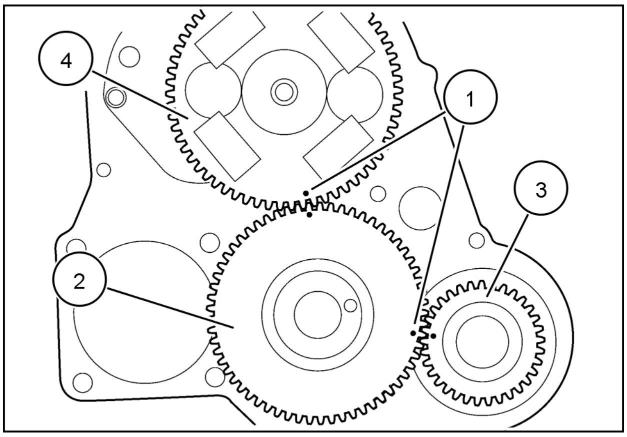
Next operation:
Timing gear - Install Idler gear, Oil pump, and Injection timing (B.10.A).

Timing gear - Install Idler gear, Oil pump, and Injection timing

Prior operation:
Timing gear - Install Camshaft and gear (B.10.A).

1. Install the thrust washer, on the idler gear shaft.
2. Align the timing marks, **(1)**, on the idler gear, **(2)**, crankshaft gear, **(3)**, and the camshaft gear, **(4)**.
3. Complete the installation of the oil pump and adjust axial clearance. See **Oil pump - Install (B.60.A)**.

NOTE: *Do not turn the crankshaft until the timing gear cover is installed.*



10044361A 1

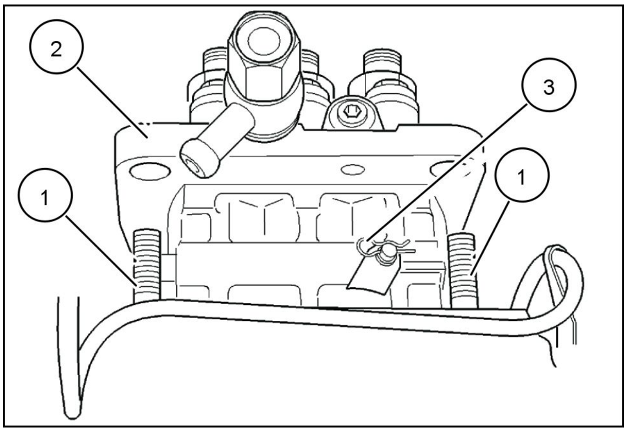
Next operation:
Timing gear housing - Install (B.10.A).

Timing gear housing - Remove

Prior operation:
Fuel Shutoff Solenoid - Removal; see **ENGINE - Disassemble (B.10.A)**.

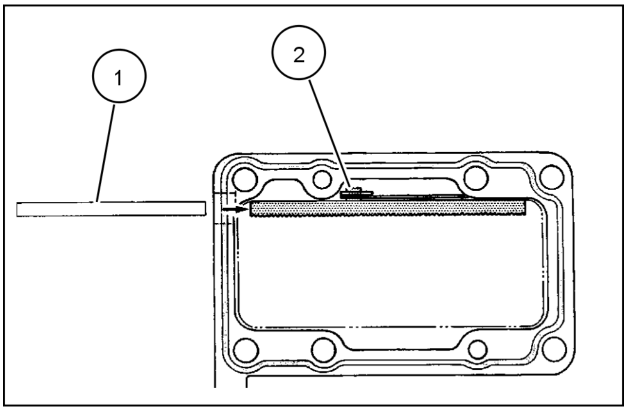
NOTE: *The prior and next operation procedures refers to engine overhaul.*

1. Drain the engine crankcase oil.
2. Remove the crankshaft pulley.
3. Loosen the injection pump mounting bolts and remove the nuts from the studs, **(1)**, and raise the injection pump **(2)**, enough to remove the spring pin, **(3)**, and separate the governor link from the control rack. Remove the injection pump.



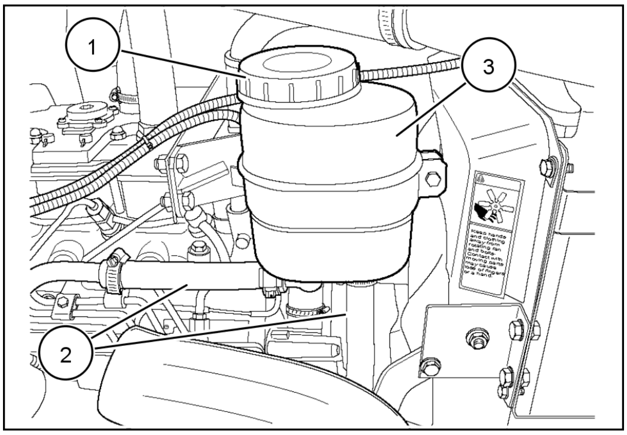
SECT10C01PG42 1

4. Insert a small dowel, **(1)**, through the fuel shutoff solenoid hole and slide the control rack, **(2)**, in to allow enough clearance to the cylinder block, for the pump to be removed.



20090010 2

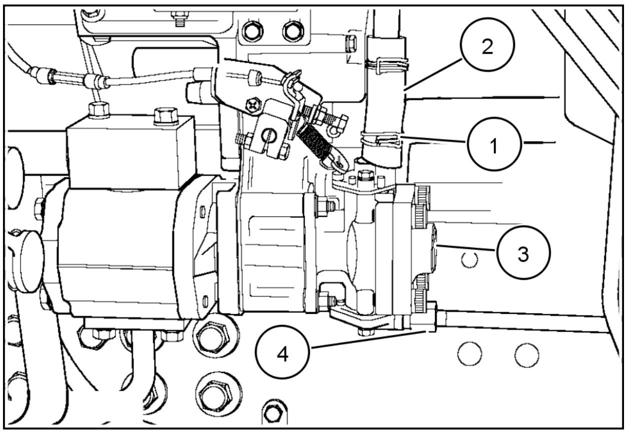
5. Remove the power steering pump reservoir tank filler cap, **(1)**.
6. Remove one of the supply tubes, **(2)**, and drain the hydraulic fluid out of the reservoir tank, **(3)**, into a suitable container.



83071900 3

7. Loosen the hose clamp, **(1)**, on the suction hose, **(2)**, and remove the suction hose from the steering pump, **(3)**.

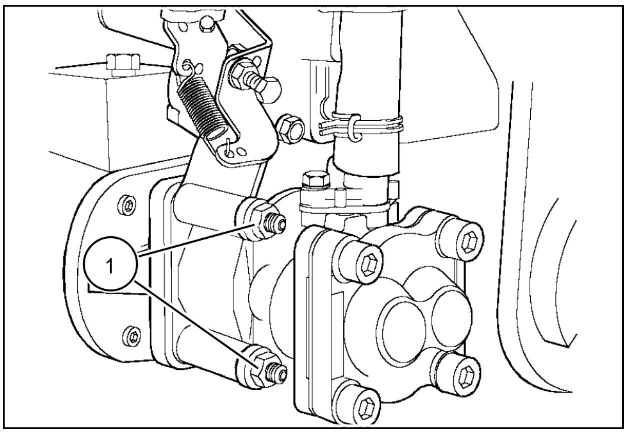
8. Remove the pressure tube, **(4)**, from the bottom of the steering pump.



20097789 4

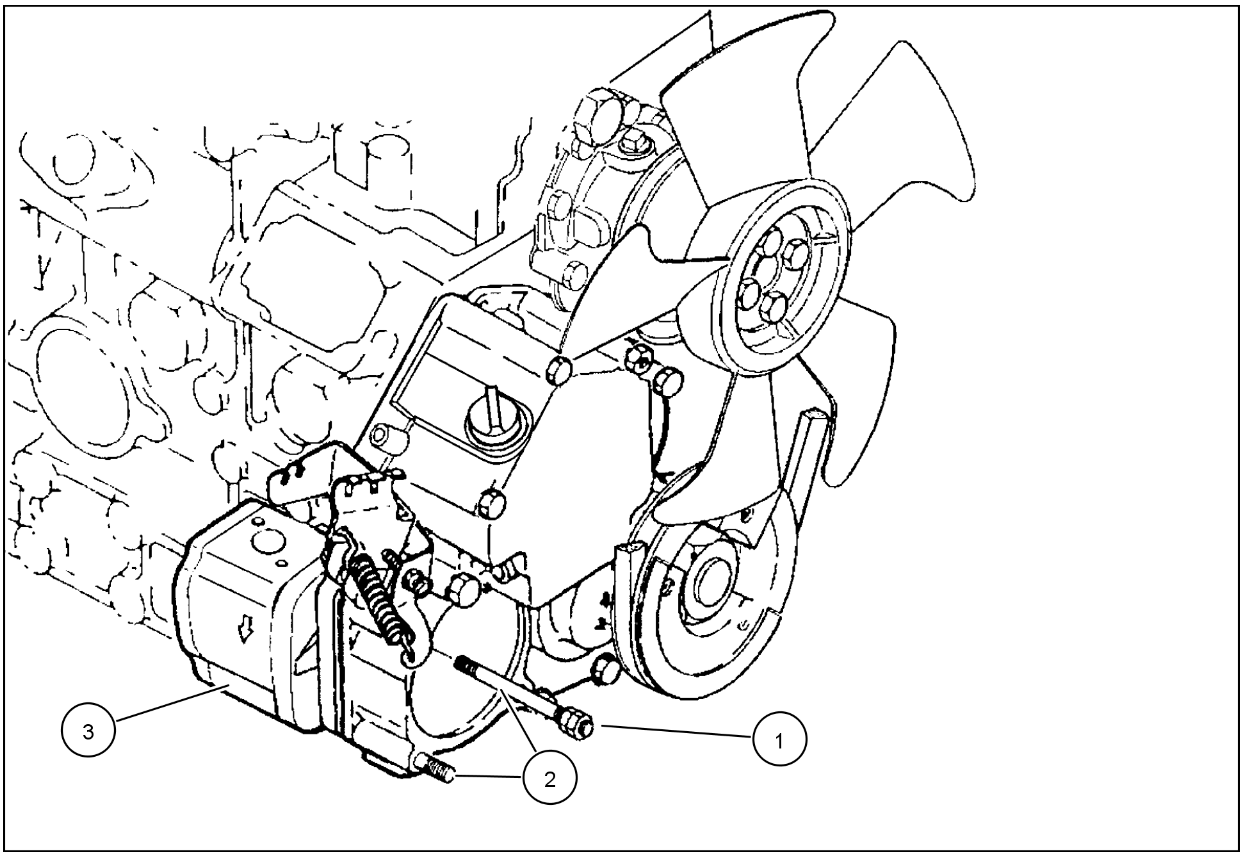
9. Remove the through bolts and nuts, **(1)**, and remove the steering pump from the front cover. Cap the lines and pump openings.

NOTE: *Two of the power steering pump retaining bolts are not shown.*



20097788 5

10. Install and tighten nuts, **(1)**, against each other, onto the retaining studs, **(2)**. Remove the studs, **(2)**, and the hydraulic pump, **(3)**.



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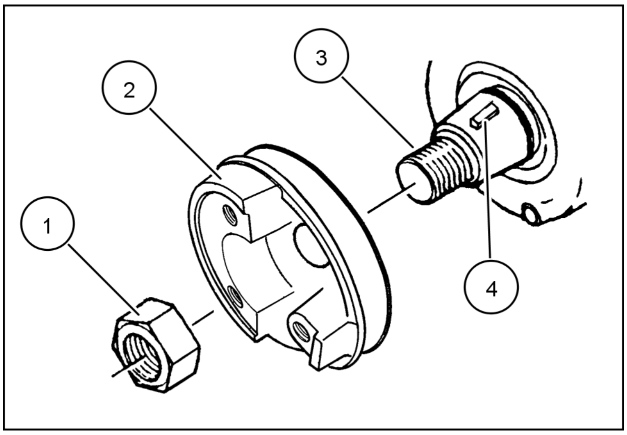
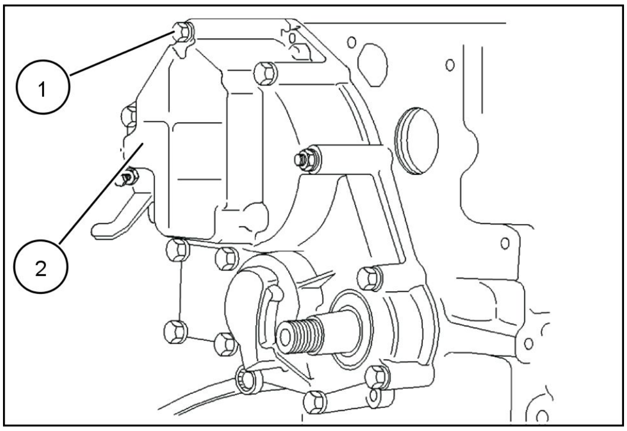
11. Remove the retaining nut, **(1)**. Pull crankshaft pulley, **(2)**, and key, **(4)**, off of crankshaft, **(3)**.



76075736 7

12. Remove the retaining bolts, **(1)**, and lift the cover, **(2)**, off the locating dowels.



SECT10C01PG44_2 8

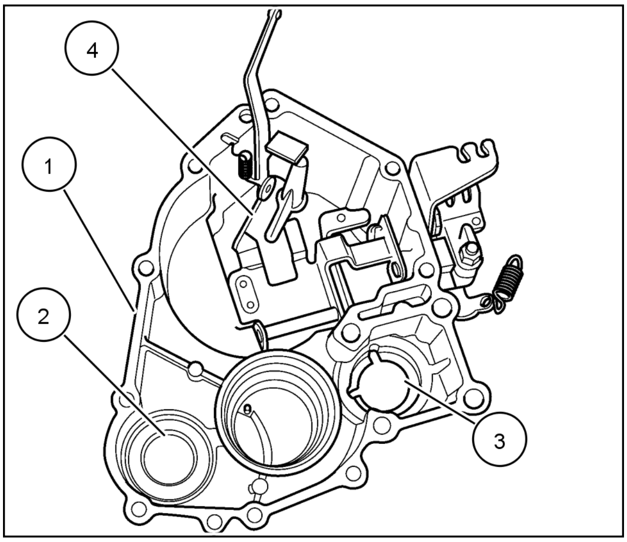
Next operation:
Timing gear - Remove - with camshaft (B.10.A).

Timing gear housing - Inspect

Prior operation:
Flywheel - Inspect (B.10.A).

NOTE: *The prior operation and next operation procedures refer to engine overhaul.*

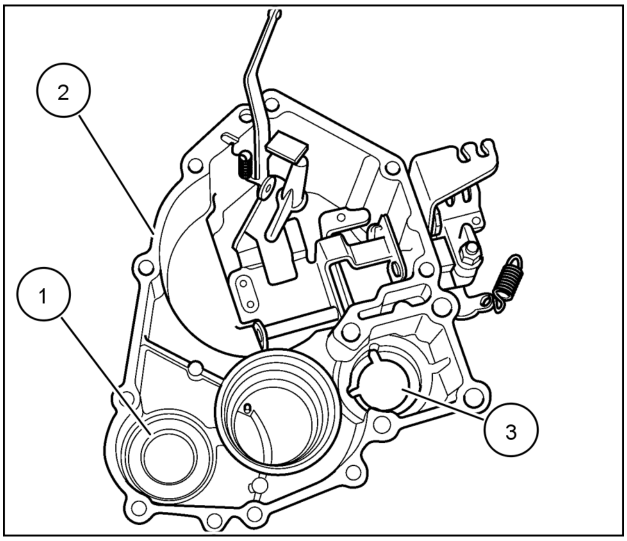
1. The timing gear housing, **(1)**, contains the front oil seal, **(2)**, power steering seal, **(3)**, and the governor linkage assembly, **(4)**. See "Governor Assembly" in **Throttle command - Assemble (B.20.A)**, for governor linkage repair and replacement procedures.



10044360A 1

Front Oil Seal and Steering Pump Seal Replacement

2. Remove the front oil seal, **(1)**, from the timing gear cover, **(2)**, and insert a new oil seal in its place.
3. Remove the steering pump seal, **(3)**, located on the front of the timing gear cover, and replace with a new seal.



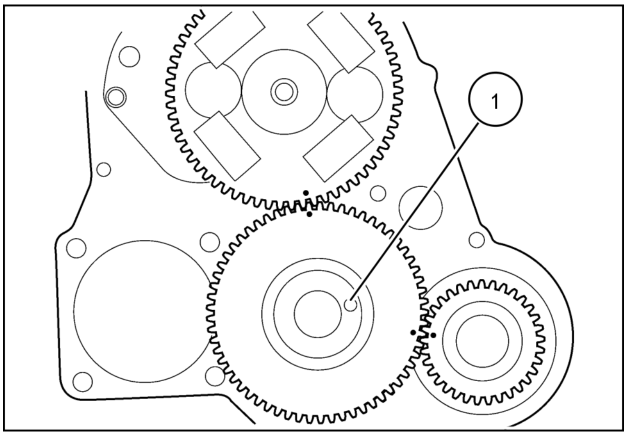
10044360B 2

Next operation:
Water pump - Inspect (B.50.A).

Timing gear housing - Install

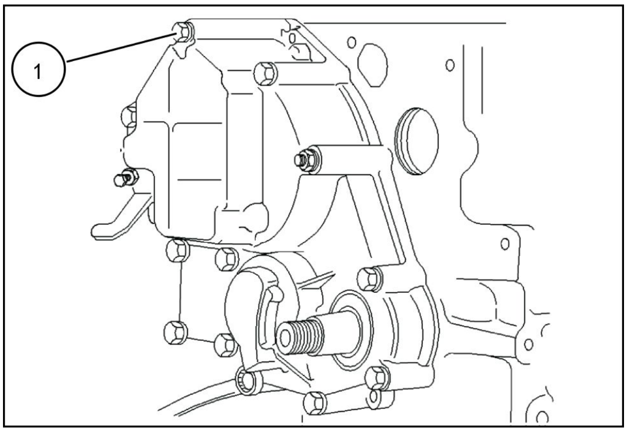
Prior operation:
Timing gear - Install Idler gear, Oil pump, and Injection timing (B.10.A).

1. Install new cover gasket.
2. Insert the governor linkage through the block.
3. Rotate the oil pump cover to position the spring pin hole, **(1)**.
4. Install cover locating pin in the oil pump cover plate.



10044361B 1

5. Install the cover retaining bolts, **(1)**.



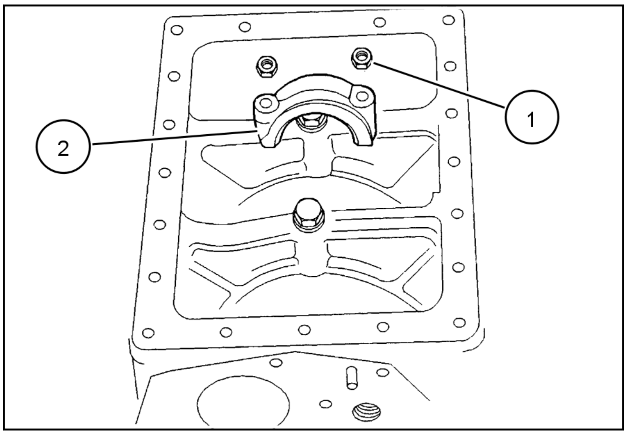
SECT10C01PA44_2 2

Next operation:
Crankshaft - Install Pulley (B.10.A).

Connecting rod and piston - Remove

Prior operation:
Balancer Assembly - Removal; See: **Balancer - Remove (B.10.A)**.

1. Remove the two nuts **(1)**, retaining the connecting rod caps **(2)**.
2. Remove the connecting rod caps and lower half of connecting rod bearing.
3. If necessary, remove any ridge from the top of the cylinder bores using a suitable ridge reamer.



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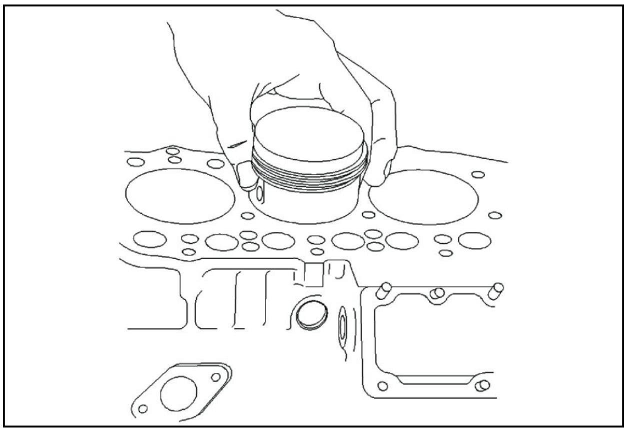
4. Push the piston and connecting rod out of the cylinder block.
5. Replace the connecting rod cap to the piston assembly it was removed from. Keep together in cylinder sequence.



SECT10C01PG46_3 2

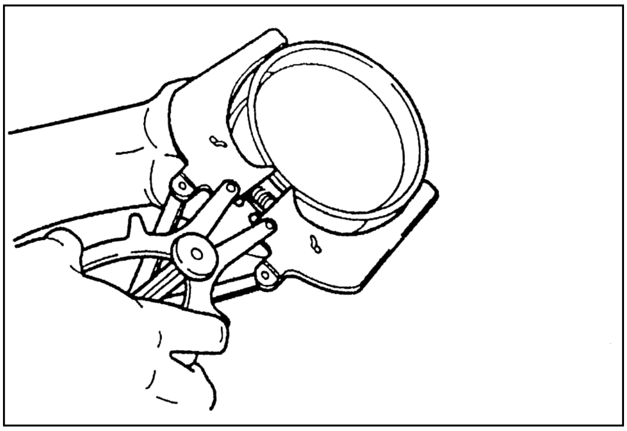
Next operation:
Flywheel - Remove (B.10.A).
Next operation:
Connecting rod and piston - Inspect - Piston (B.10.A).

Connecting rod and piston - Inspect - Piston

Prior operation:
Cylinder block - Inspect (B.10.A)
Prior operation:
Connecting rod and piston - Remove (B.10.A)

Disassembly and Inspection

1. Remove the piston rings using a piston ring tool.



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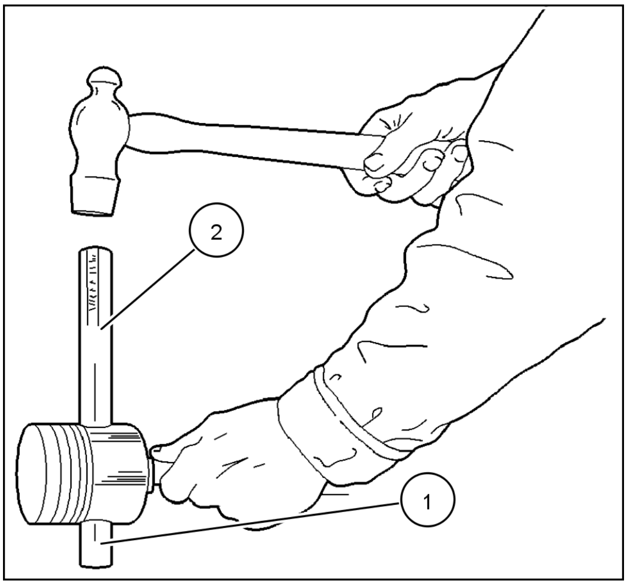
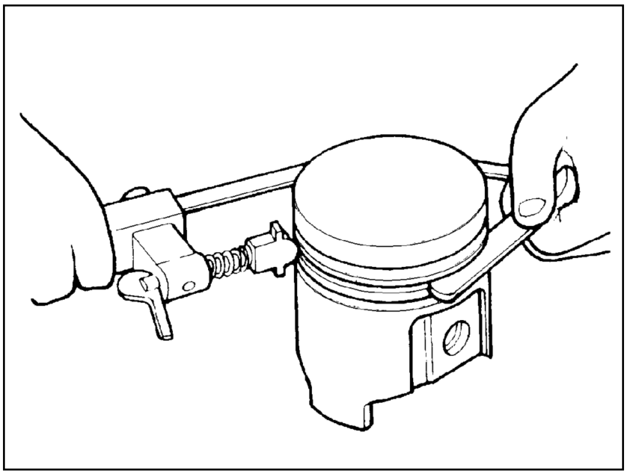
2. Remove the wrist pin, **(1)**, retaining rings and drive the wrist pin out of the piston using a suitable tool, **(2)**.



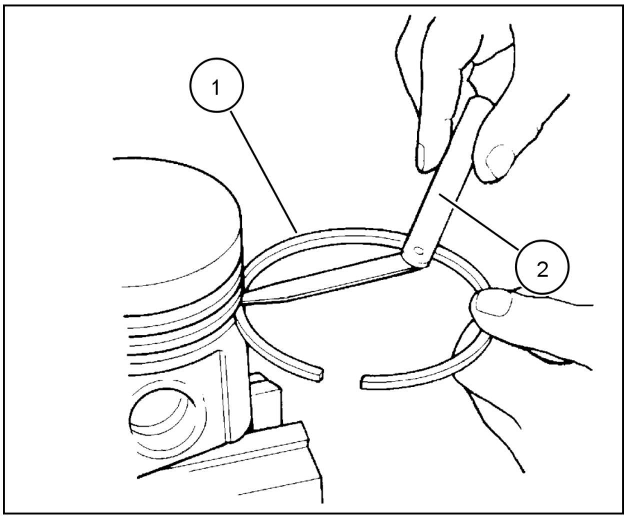
20093381 2

3. Wash the pistons and connecting rods in a suitable solvent and air dry.
4. Using a groove cleaner, remove the carbon deposits from the ring grooves. Be careful to avoid cutting any metal from either side or the bottom of the grooves.



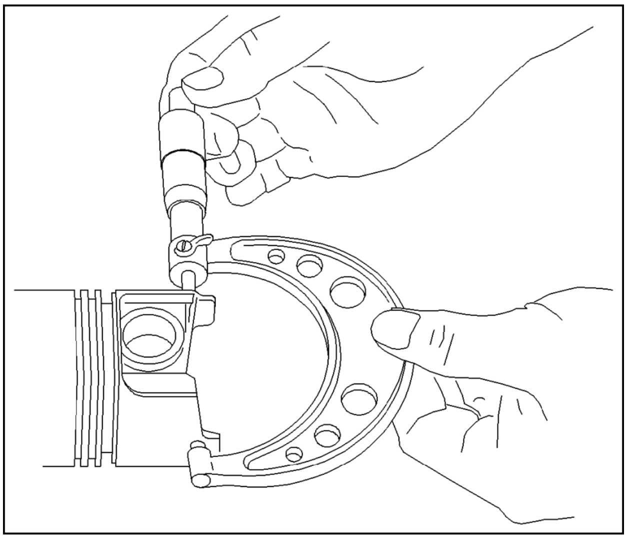
20093382 3

5. Inspect the piston ring lands for excessive wear. Use a new ring, **(1)**, and feeler gauge, **(2)**, to check the ring side clearance. Replace pistons having a ring side clearance exceeding the following dimensions:
   - Compression Ring = **0.25 mm** (**0.010 in**).
   - Oil Control Ring = **0.25 mm** (**0.010 in**).



20093383 4

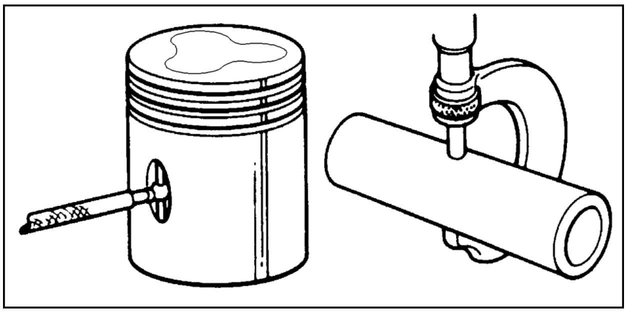
6. Using a micrometer, check the piston diameter at **90 °** from the wrist pin bore. Replace pistons that are worn to less than the following dimension (All Models):
   - Wear Limit = **83.9 mm** (**3.3 in**).



20093384 5

7. Using a telescoping gauge and a micrometer, measure the piston pin bore and the wrist pin diameter. Replace piston and/or wrist pins that exceed the following limits:
   - Bore Diameter: **28.0 mm** (**1.102 in**).
   - Pin Diameter: **27.98 mm** (**1.101 in**).
   - Clearance: **0.02 mm** (**0.0008 in**).

NOTE: *In some instances the wrist pin diameter may be equal to or slightly larger than the wrist pin bore. This interference fit is normal.*



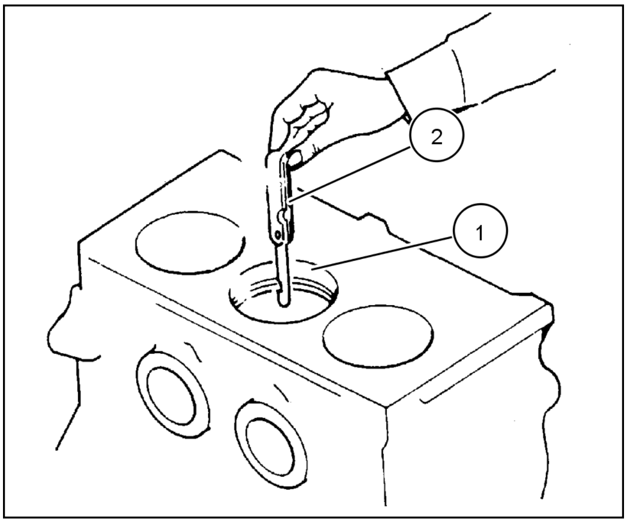
20093385 6

Next operation:
Connecting rod and piston - Inspect - Piston rings (B.10.A)

Connecting rod and piston - Inspect - Piston rings

Prior operation:
Connecting rod and piston - Inspect - Piston (B.10.A).

1. Position the piston rings **(1)**, one at a time, in the cylinder to the lowest point of travel. Use an inverted piston to square the ring in the bore.
2. With a feeler gauge, **(2)**, measure the ring gap. The ring is shown at the top of its travel for clarity.
3. Replace worn rings with end gap clearance in excess of **1.0 mm** (**0.039 in**).

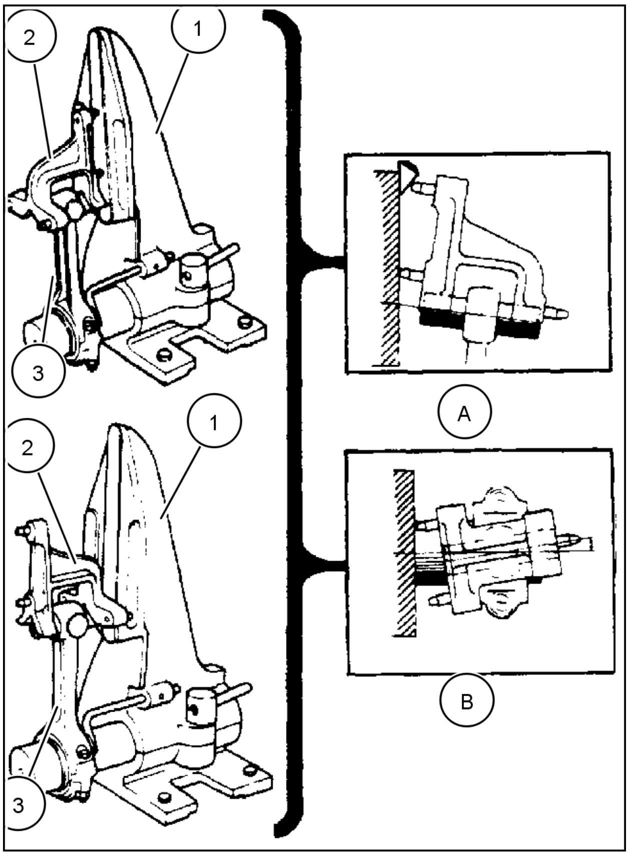


20093386 1

Next operation:
Connecting rod and piston - Inspect - Connecting rod (B.10.A).

Connecting rod and piston - Inspect - Connecting rod

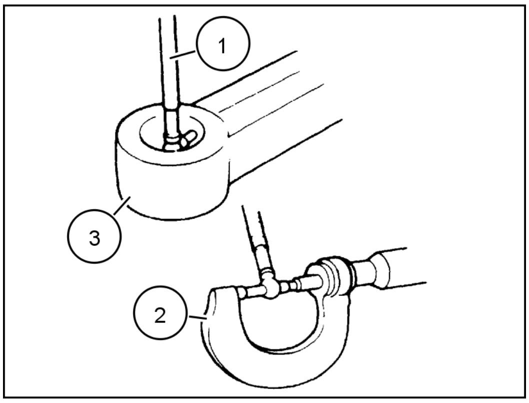
Prior operation:
Connecting rod and piston - Inspect - Piston rings (B.10.A).



20093387 1

(1) Alignment Fixture
(2) Gauge
(3) Connecting Rod
(A) Bent Rod
(B) Twisted Rod

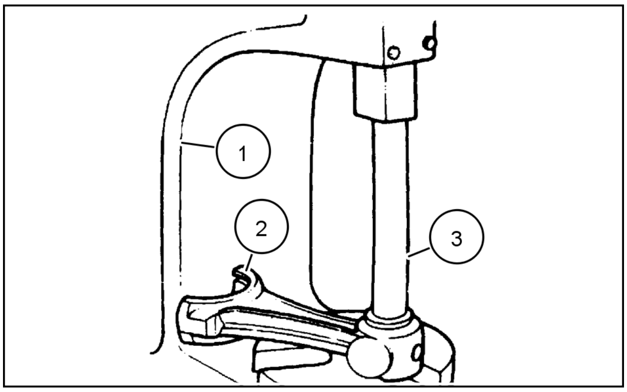
1. Check the connecting rods for damage and alignment. Place each rod in an alignment fixture to check for bent or twisted condition.
2. Straighten or replace rods that are bent or twisted more than the following dimensions:
    - Max. Bend: **0.15 mm** (**0.0059 in**) per **100 mm** (**3.94 in**).
    - Twist: **0.2 mm** (**0.0078 in**) per **100 mm** (**3.94 in**).



20093388B 2

(1) Hole Gauge
(2) Micrometer
(3) Connecting Rod

3. Using a telescoping gauge and a micrometer, measure the inside diameter of the connecting rod wrist pin bushing.
4. Replace bushings measuring more than the following (All Models)::
   - Max. Inside Diameter = **28.021 mm** (**1.103 in**).

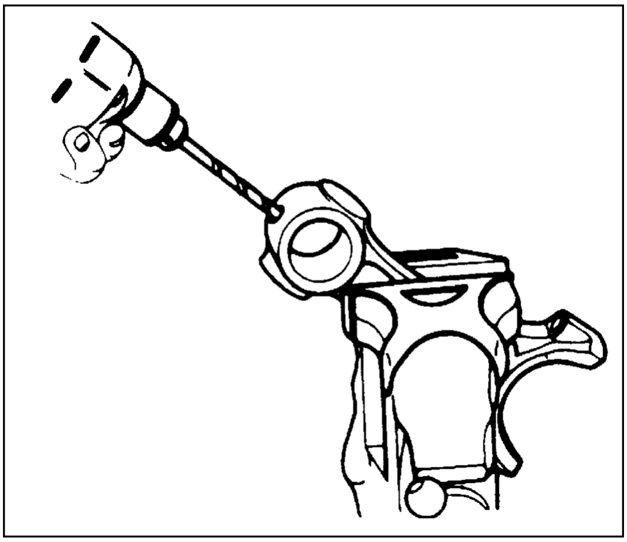


20093389 3

(1) Press
(2) Connecting Rod
(3) Bushing Driver

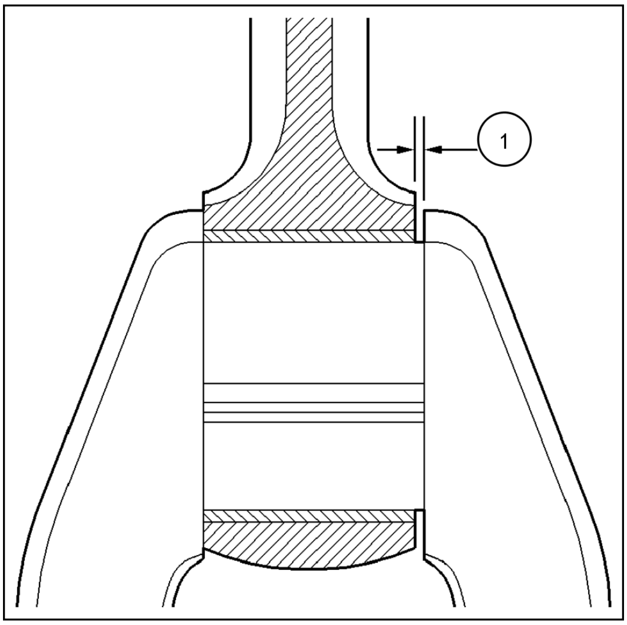
5. Remove and install the connecting rod wrist pin bushings using a suitable driver and press a new bushing into the rod bore.
6. Ream and hone the bushing to the following finish size:
   - Pin to Bushing Clearance:
     - Standard = **0.010 - 0.025 mm** (**0.00039 - 0.00098 in**).
     - Max. = **0.08 mm** (**0.0031 in**).

7. When installing a new piston bushing, use the hole in the rod and drill a lube hole in the new bushing



20093390 4

8. Install the connecting rod on the crankshaft and measure the play in shaft direction. If the play is more than **0.7 mm** (**0.028 in**), replace the connecting rod.



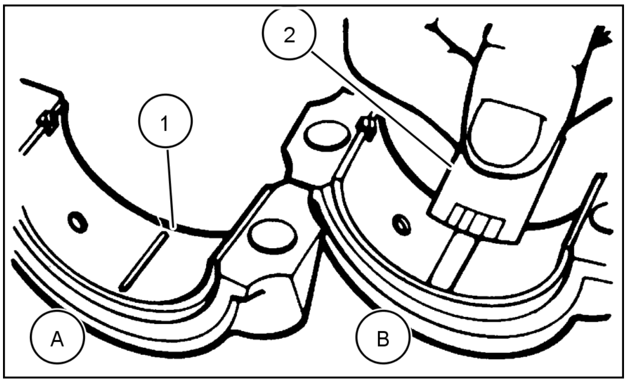
20093391 5

(1) Side Clearance Check **0.7 mm** (**0.028 in**) Max.

Next operation:
Connecting rod and piston - Inspect - Connecting rod bearing (B.10.A).

Connecting rod and piston - Inspect - Connecting rod bearing

Prior operation:
Connecting rod and piston - Inspect - Connecting rod (B.10.A).



20093392 1

(1) Plastigauge
(2) Bearing Clearance Check
(A) Start
(B) Flattened

Clearance Check

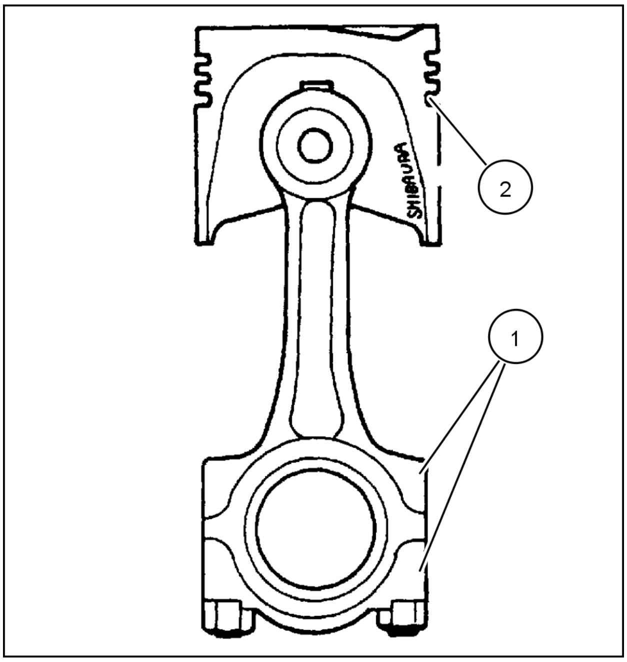
1. Remove oil or foreign matter from the bearing and crankshaft.
2. Cut a piece of plastigauge **(1)**, to the same width as the bearing. Place it on the crankshaft. Avoid the oil hole.
3. Install the rod cap and torque to **49.0 - 53.9 N·m** (**36.2 - 39.8 lb ft**).
4. Remove the rod cap and measure the width of the flattened plastigauge using the plastigauge scale.
5. The width of the widest flattened plastigauge is the minimum clearance and the width of the narrowest plastigauge is the greatest clearance. Select the proper size bearing liners to obtain the correct clearance. See "Specifications".

Next operation:
Connecting rod and piston - Assemble (B.10.A).

Connecting rod and piston - Assemble

Prior operation:
Connecting rod and piston - Inspect - Connecting rod bearing (B.10.A).

1. Assemble the pistons and connecting rods with the matching marks, **(1)**, on the rods on the same side as the trade name "SHIBAURA", **(2)**, embossed on the inside of the piston skirt. Install the piston pin, and retaining rings.



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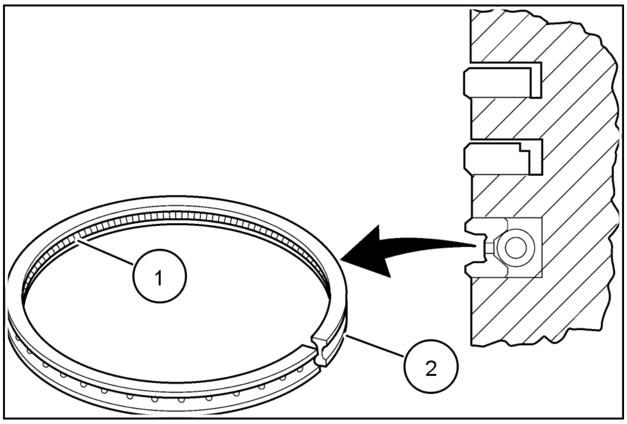
2. Using a suitable ring expander tool, install the piston rings positioning the ring gaps at approximately **120** ° from each other. Install the third (oil ring) first as follows:
   - Put the expander ring, **(1)**, into position in its groove.
   - Fit the outer oil ring, **(2)**, into position in its groove, while making sure the outer oil ring gap is diametrically opposite to the joint on the expander ring, **(1)**.



10044359 2

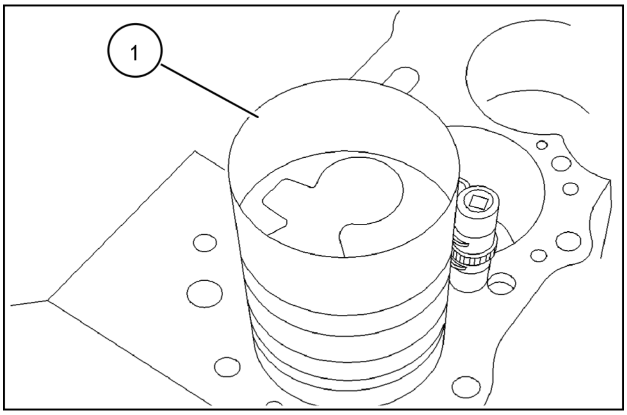
Next operation:
Connecting rod and piston - Install (B.10.A).

Connecting rod and piston - Install

Prior operation:
Connecting rod and piston - Assemble (B.10.A)
Prior operation:
Flywheel - Install (B.10.A).

1. Coat the bearing faces, pistons, and piston rings with clean engine oil. Slide the piston rings to permit a sufficient amount of oil to be applied in the grooves.
2. Set the piston ring gaps **90 °** apart from each other. Do not position these gaps toward the piston pin or the right angle of the pin.
3. Using a piston ring compressor, **(1)**, insert the pistons in the cylinders with the prechamber side of the piston facing the injection pump side. The connecting rod marks should also face the injection pump side.

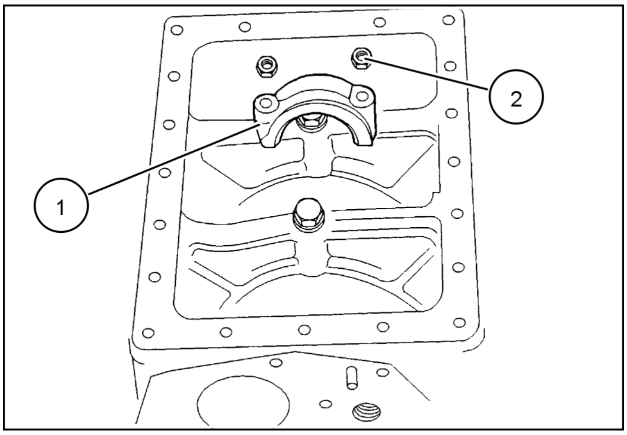
NOTE: *Install the pistons from the front to the rear in order.*



20093408 1

4. Install the connecting rod caps, **(1)**, making sure the rod and cap matching marks align. Tighten the connecting rod nuts, **(2)**, to **49 - 54 N·m** (**36 - 40 lb ft**).

NOTE: *After installation, ensure the crankshaft moves freely. Ensure the axial play of* ***0.1 - 0.3 mm*** *(****0.004 - 0.012 in****) is provided.*



76075710A 2

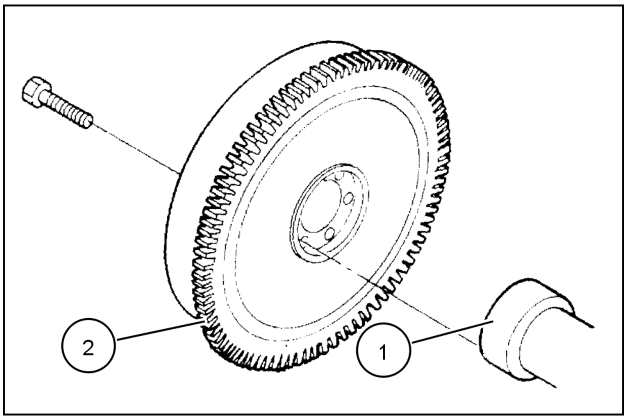
Next operation:
Balancer - Install (B.10.A).

Flywheel - Remove

Prior operation:
Connecting rod and piston - Remove (B.10.A).

NOTE: *The prior operation and next operation procedures refer to engine overhaul.*

1. Loosen the flywheel retaining bolts.
2. Using a brass drift and hammer, tap the end of the crankshaft **(1)**, to loosen the flywheel **(2)**, from the shaft.



20093407 1

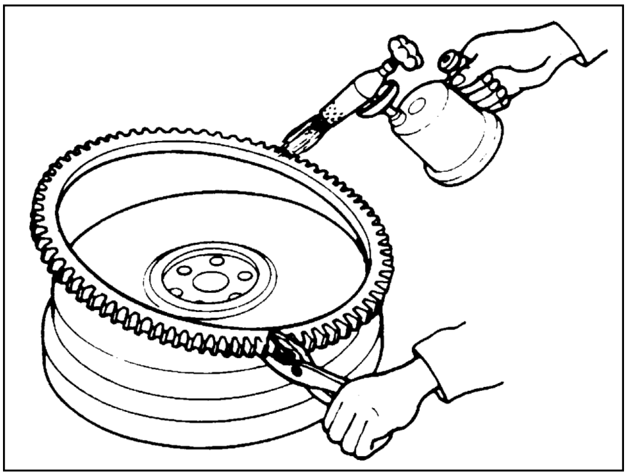
Next operation:
Backplate and Oil Seal - Remove; See: **ENGINE - Disassemble (B.10.A)**.

Flywheel - Inspect

Prior operation:
Timing gear - Inspect Camshaft (B.10.A).

NOTE: *The prior operation and next operation procedures refer to engine overhaul.*

1. Inspect the ring gear for cracked, broken, chipped, or worn gear teeth. If found damaged, replace the ring gear.
2. If necessary, remove the starter ring gear using a hammer and chisel to crack the ring gear.
3. To reinstall a new ring gear, heat the new ring gear to **120 - 150 °C** (**245 - 300 °F**) from the inside only. Be careful not to overheat the ring gear teeth. Use a temperature sensitive crayon to mark the inside of the ring gear. Quench the ring gear quickly to obtain a good shrink fit onto the flywheel.



20093403 1

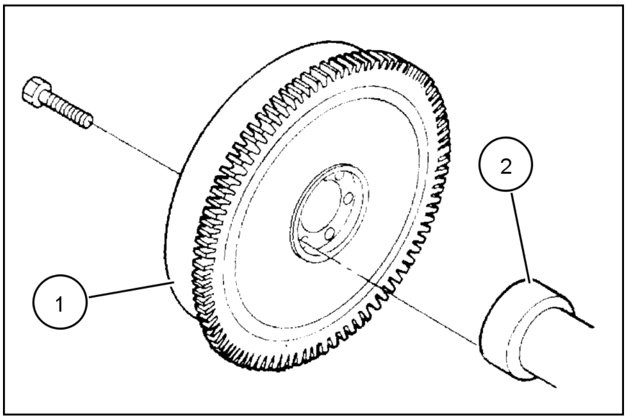
Next operation:
Timing gear housing - Inspect (B.10.A).

Flywheel - Install

Prior operation:
Rear Oil Seal and Backplate Install; see: **ENGINE - Assemble (B.10.A)**.

NOTE: *The prior operation and next operation refer to engine overhaul.*

1. Fit the flywheel, **(1)**, to the crankshaft, **(2)**, and align the bolt holes.
2. Install the flywheel retaining bolts and tighten to **69 - 78 N·m** (**51 - 57 lb ft**).



20093407A 1

Next operation:
Connecting rod and piston - Install (B.10.A).

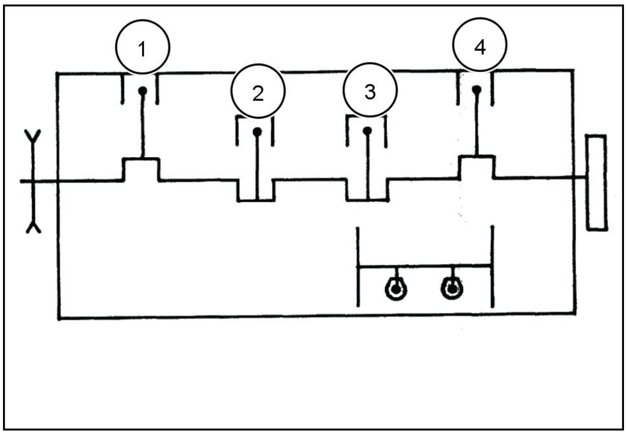
Balancer - Install

Prior operation:
Connecting rod and piston - Install (B.10.A).

NOTE: *The prior operation and next operation procedures refer to engine overhaul.*

NOTE: *The balancer assembly on the ISM N844L (WORKMASTER 45) engine is different than the balancer assembly on the ISM N844LT (WORKMASTER 55) engine due to the ISM N844LT engine's different connecting rods and longer piston stroke.*

1. Position the cylinder block with the oil pan mounting surface facing down.
2. Position the No. **(1)**, and the No. **(4)** pistons at top dead center.



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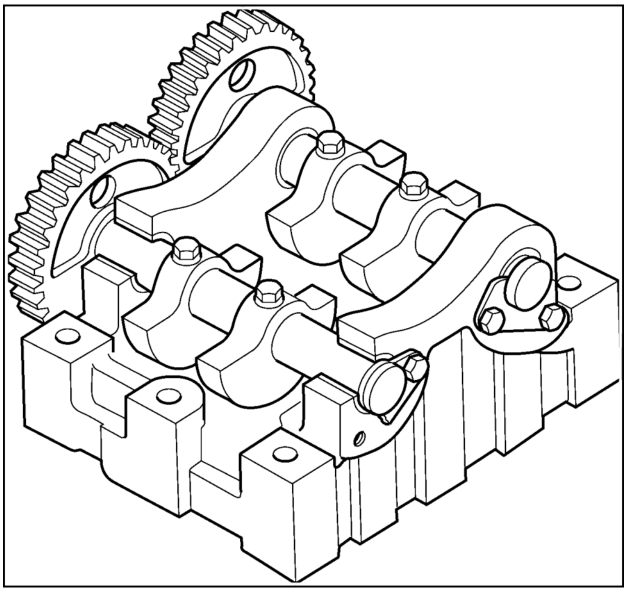
NOTE: *When positioning balancer assembly for installation to engine, be sure balancer weights are oriented with weights down towards oil pan (flats on weights should be facing as shown).*



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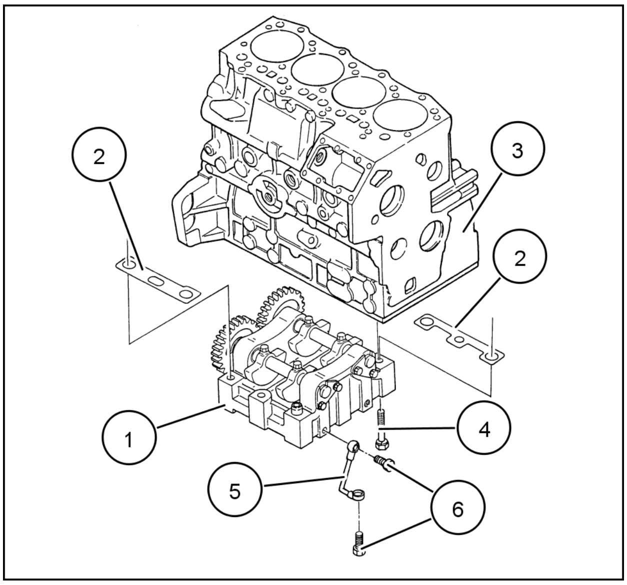
3. With the balancer weights centered straight down (weights facing away from engine block), position the balancer assembly, **(1)**, and the original quantity of shims, **(2)** (if used) on the cylinder block, **(3)**, using the dowel pins for alignment.
4. Install the retaining bolts, **(4)**, and tighten to **49 - 53.9 N·m** (**36.2 - 39.8 lb ft**).
5. Install the oil transfer pipe, **(5)**, and secure with the banjo bolts, **(6)**.

NOTE: *If required, inspect the backlash between the balancer gear and the drive gear. Adjust the backlash to* ***0.2 - 0.4 mm*** *(****0.008 - 0.016 in****) using shims.*



20002374B 3

Balancer Shims

Engine	Model	Shim Thickness
ISM N844L	WORKMASTER 45	**0.1 mm** (**0.004 in**)
ISM N844LT	WORKMASTER 55	**0.2 mm** (**0.008 in**)

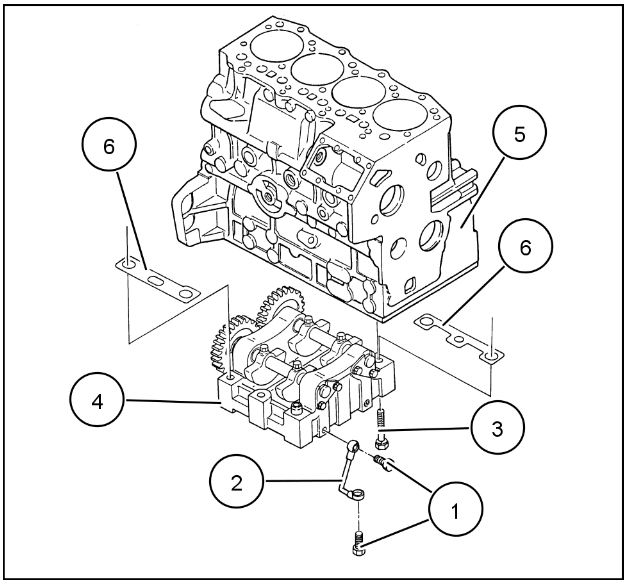
Next operation:
Oil pump - Install Oil suction pipe and suction strainer (B.60.A).

Balancer - Remove

Prior operation:
Oil pump - Remove - Suction pipe and strainer (B.60.A).

1. Remove the banjo bolts, **(1)**, and the oil transfer pipe, **(2)**.
2. Loosen and remove the balancer retaining bolts, **(3)**.
3. Remove the balancer assembly, **(4)**, from the engine block, **(5)**.

NOTE: *Observe the quantity and thickness of the shims,* ***(6)****, (if used) for reinstallation upon assembly.*



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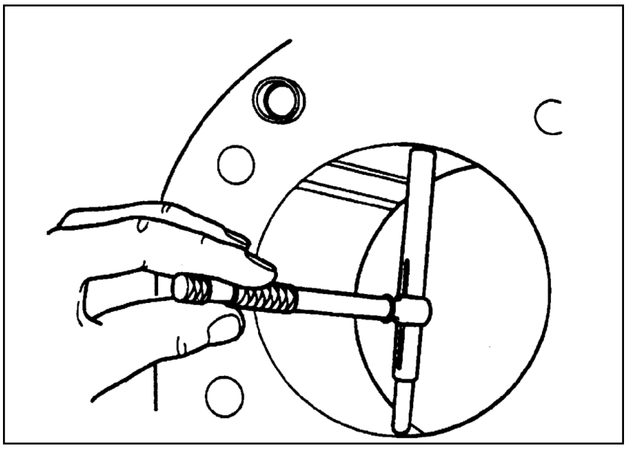
Next operation:
Balancer - Install (B.10.A).

Cylinder block - Inspect

Prior operation:
Cylinder head - Assemble (B.10.A).

NOTE: *The prior operation and next operation procedures refer to engine overhaul.*

1. Inspect the cylinder block top face for cracks, damage, and warping in the same way as for the cylinder head. Replace the cylinder block if warp is greater than **0.12 mm** (**0.005 in**).
2. Visually inspect the cylinder bore. There should be no scoring, rust, or corrosion.
3. Using a telescoping gauge in line with the crankshaft, measure the inside diameter of the top of the bore (approximately **15 mm** (**0.59 in**) below the top of the block) on all models.
4. Repeat this measurement at right angles to the crankshaft at the same distance.
5. In line with the crankshaft at the bottom of the bore, measure (approximately **117 mm** (**4.6 in**) Model ISM N844L, and **127 mm** (**5 in**) Model ISM N844LT) from the top of the cylinder.



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6. Repeat this measurement at right angles to the crankshaft at the same distance.
7. If any of the measurements taken indicate worn or damaged cylinder bores, replace engine block with a long block assembly.

NOTE: *If the cylinder bore measures **84.2 mm** (**3.315 in**) long replace the block assembly.*

Next operation:
Connecting rod and piston - Inspect - Piston (B.10.A).

Cylinder head - Replace Gasket

During assembly, the ultimate engine compression ratio is established by the thickness of the head gasket used. For service replacement, head gaskets of different thickness are available. The correct head gasket must be selected based upon the amount the piston protrudes above the face of the block when at top dead center. The correct head gasket usage is determined as follows:

Prior operation:
Hydraulic pump - Install Engine mounted (A.14.A).

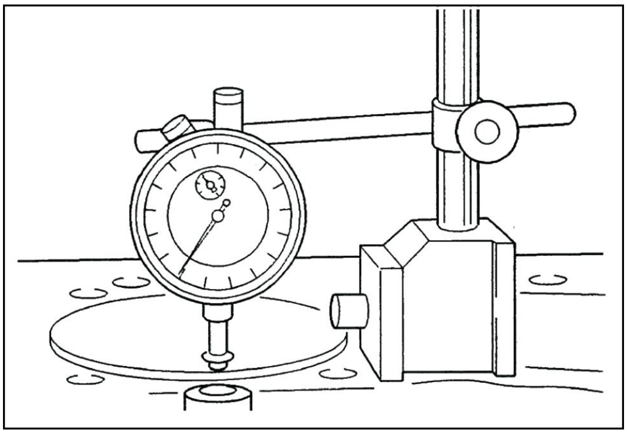
NOTE: *The prior operation procedure refers to engine overhaul.*

Head Gasket Selection

1. Position each of the pistons at top dead center and, using a dial indicator, determine the distance each piston projects above the face of the block.

NOTE: *Measure each of the pistons while holding a slight down pressure on the piston. Use the dimension taken from the cylinder which has the greatest projection and select a head gasket as indicated in the following chart.*

NOTE: *The variation in the amount of protrusion among all pistons must be within **0.1 mm** (**0.004 in**).*



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Selection Chart

Model	Measurement Value	Head Gasket Part No.	Installed Thickness
ISM N844L (WORKMASTER 45)	**0.5 - 0.6 mm** (**0.0197 - 0.0236 in**)	111147510	**1.2 mm** (**0.0472 in**)
	0.6 - 0.7 mm (**0.0236 - 0.02756 in**)	111147520	**1.3 mm** (**0.0512 in**)
ISM N844LT (WORKMASTER 55)	**0.5 - 0.6 mm** (**0.0197 - 0.0236 in**)	1111477711	**1.2 mm** (**0.0472 in**)
	0.6 - 0.7 mm (**0.0236 - 0.02756 in**)	111147721	**1.3 mm** (**0.0512 in**)

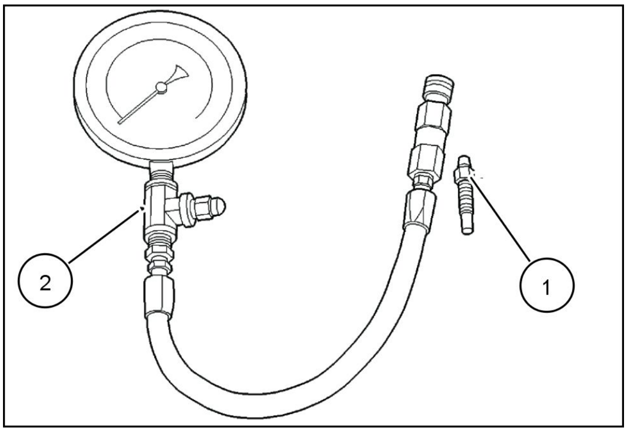
Next operation:
Cylinder head - Install (B.10.A).

Cylinder head - Compression test

Compression test is performed through the glow plug ports. The test adapter tool **(1)**, is equipped with quick coupler ends for easy installation of the hose and gauge.

The procedures to perform a compression test are as follows:

1. Remove the wire lead from the fuel injection pump solenoid.
2. Remove the glow plug electrical wire and wire connector from top of the glow plugs.
3. Remove all of the glow plugs.



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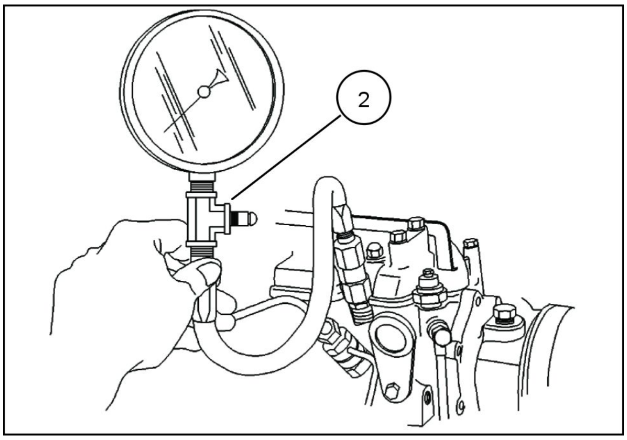
NOTE: *Be sure all the glow plugs are removed before starting the compression tests.*

4. Install the adapter Tool No. **FNH00120**, hose and gauge assembly **OEM1074 (2)**, in each port and crank the engine until pressure stabilizes. The gauge should read **2944.1 kPa** (**427 psi**) plus or minus **344.7 kPa** (**50 psi**).



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NOTE: *It may be necessary to remove some injector fuel lines to install the adapter tool.*

NOTE: *There should not be more than **344.7 kPa** (**50 psi**) variation between the cylinders.*

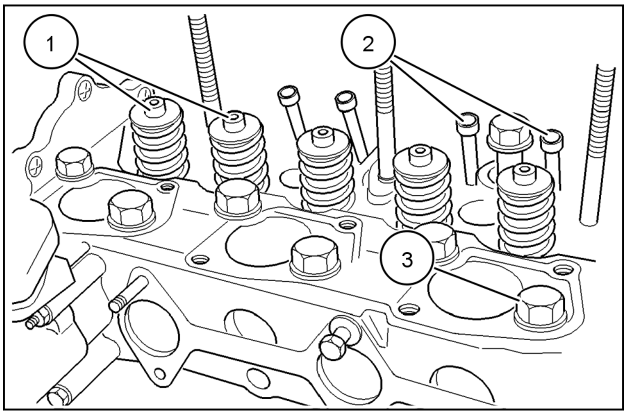
5. When all cylinders have been tested, reinstall the glow plugs and electrical connections.

Cylinder head - Remove

Prior operation:
Rocker Arm Shaft and Support Bracket - Remove; See: **ENGINE - Disassemble (B.10.A)**.

1. Remove the valve stem caps, **(1)**, and push rods, **(2)**.
2. To remove the cylinder head, remove the cylinder head bolts, **(3)**, by alternately loosening a half turn at a time to prevent warping the head.

NOTE: *Keep all valve components in separately marked containers for reassembly in their original location.*



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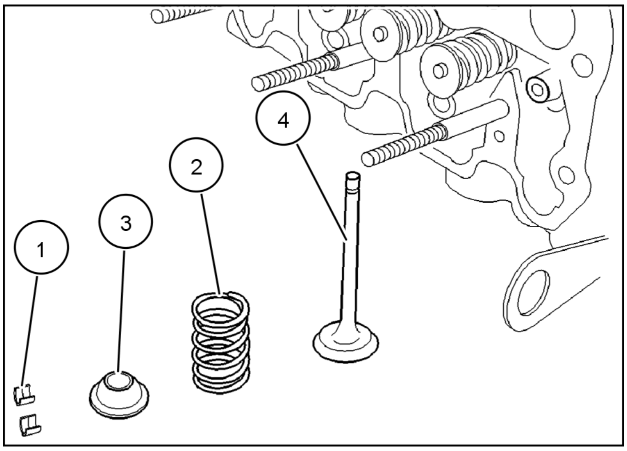
Next operation:
Cylinder head - Inspect (B.10.A)
Next operation:
Valve Tappet - Removal; See: **ENGINE - Disassemble (B.10.A)**.

Cylinder head - Inspect

Prior operation:
Cylinder head - Remove (B.10.A).

1. Disassembly
    1. Clean the cylinder head and remove any carbon deposits from around the valve heads.
    2. Use a valve spring compressor and remove the valve spring retainer locks, **(1)**, spring, **(2)**, and spring retainer, **(3)**, from each valve, **(4)**.
    3. Remove the valves and place the valve components together in separately marked containers for reassembly in their original position.



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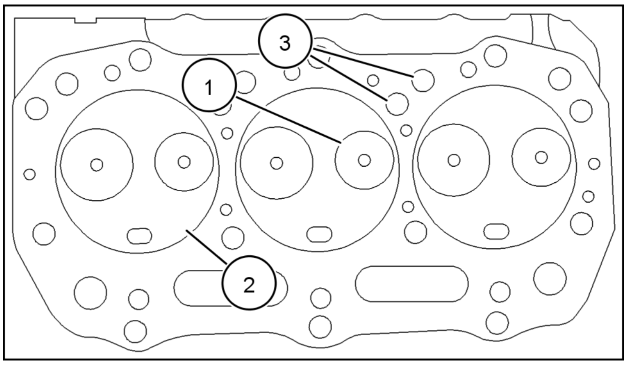
2. Inspection and Repair
    1. Clean all carbon deposits from the combustion chamber and valve ports using a wire brush and scraper.
    2. Clean all dirt and residue from the gasket surface using care not to scratch or nick the machined surface.
    3. Clean the cylinder head in solvent and air dry.
    4. Inspect the head for cracks or damage in the following areas:
        - Valve ports
        - Valve seats, **(1)**.
        - Prechamber, **(2)**.
        - External cracks in the water jackets, **(3)**.
    5. Inspect the gasket surfaces for scratches or nicks, which could cause leakage.
    6. Examine the core hole plugs for rust or signs of leakage. If a plug shows signs of damaging rust or leakage, replace all plugs in the head.
    7. Inspect the prechamber for carbon deposits and looseness. Remove any carbon deposits found. If prechamber is found to be loose, cylinder head may be warped.



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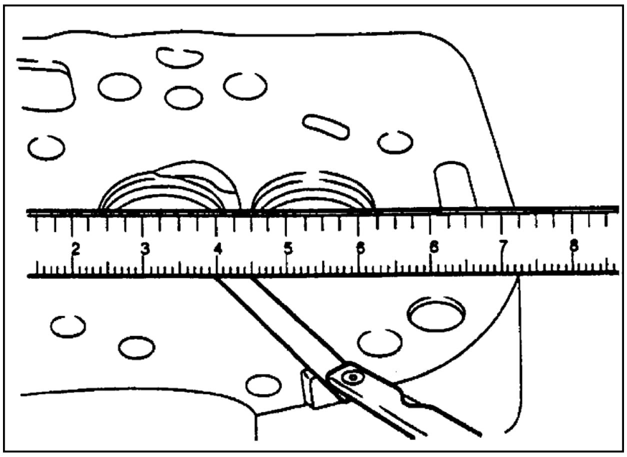
3. Inspection, Continued
    - Use a straight edge and a feeler gauge and check the cylinder head for warp lengthwise, crosswise, and diagonally



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Next operation:
Valve drive - Inspect - Valve seats (B.10.A).

Cylinder head - Assemble

Prior operation:
Valve drive - Inspect - Push rods (B.10.A).

NOTE: *The prior and next operation procedures refer to engine overhaul.*

1. Insert each valve in the guide from which it was removed and lightly lap the valve to be sure of an even seat around the valve face. Remove the valve and remove all traces of lapping compound.
2. Install new intake valve seals on the valve guides using a suitable driver.
3. Using a spring compressor, assemble the valves, springs, retainers, and keepers.

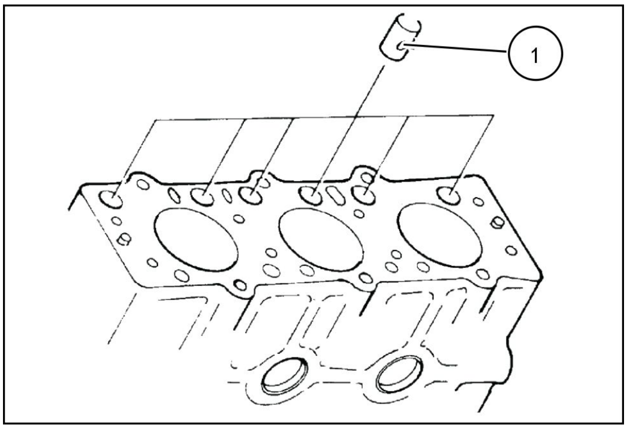
NOTE: *To install the cylinder head refer to:* ***Cylinder head - Install (B.10.A)***

Next operation:
Cylinder block - Inspect (B.10.A).

Cylinder head - Install

Prior operation:
Cylinder head - Replace Gasket (B.10.A).

1. Install the valve tappets, **(1)**.



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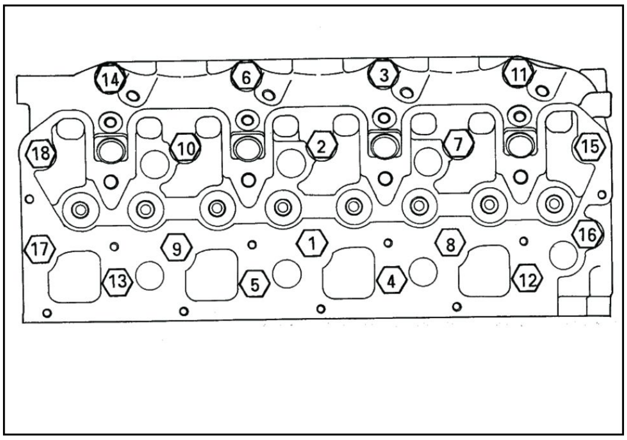
2. Select the proper head gasket and place it on the block with the side marked with the last four digits of the part code no. up.
3. Tighten the head bolts in the sequence as shown. Tighten first to half torque value, then to the final torque specification of **98 - 103 N·m** (**72.3 - 76 lb ft**).
4. Replace the push rods and valve stem caps in their original location.
5. Install the rocker shaft support assembly onto the head and tighten the bolts to **27 - 39 N·m** (**20 - 29 lb ft**).



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NOTE: *The next operation procedure refers to Engine Overhaul.*

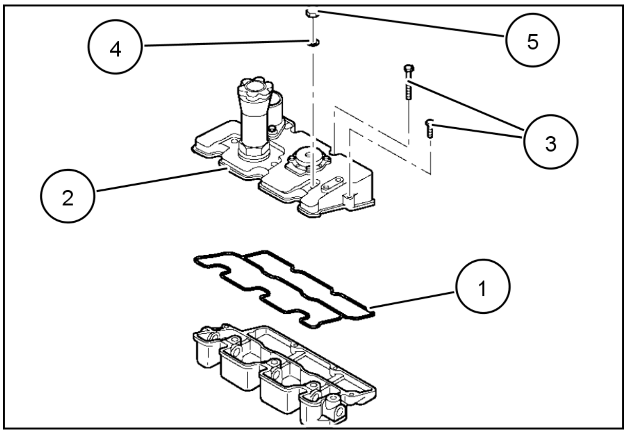
Next operation:
Valve drive - Clearance Valves (B.10.A)

Valve cover - Install

Prior operation:
Valve drive - Clearance Valves (B.10.A).

NOTE: *The prior and next operation procedures refer to engine overhaul.*

1. Install a new gasket, **(1)** and position the valve cover, **(2)** over the rocker arms.
2. Install the valve cover retaining bolts, **(3)**, and tighten to **12 - 16 N·m** (**9 - 19 lb ft**).
3. Install and tighten the seal washer, **(4)**, and cap nuts, **(5)**.



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Next operation:
Water pump - Install with cooling fan (B.50.A).

ENGINE - Troubleshooting

Problem	Possible Cause	Correction
Engine does not develop full power	Clogged air cleaner	Inspect and replace air cleaner if necessary
	Fuel line obstructed	Check for crimped fuel line. Inspect fuel lifter for cleanliness
	Improper injection timing	Repair/replace components as required
	Improper nozzle injection pressure and angle	Check injection timing, inspect for proper injection pressure and angle
	Low cylinder compression	Check engine compression
	Insufficient fuel injection	Repair at authorized shop
	Improper valve lash adjustment	Adjust valves to correct tolerances
	Burned, worn or sticking valves	Inspect and replace as necessary
	Blown head gasket	Replace head gasket
	Worn or sticking piston rings	Overhaul as necessary
	Faulty engine stop solenoid	Replace stop solenoid
Low oil pressure	Engine oil level low	Fill to proper level
	Wrong grade of oil	Replace with correct grade oil
	Clogged oil pump filter	Change oil and filter
	Faulty oil pressure relief valve	Replace relief valve
	Worn oil pump drive shaft gears, or broken oil pipe	Inspect oil system and components. Replace defective components
	Excessive main or connecting rod bearing clearances	Replace bearings or shaft if necessary
	Oil pump axial clearance not properly set	Check pump clearance and shim as needed to proper tolerance.
Engine will not stop	Faulty engine stop solenoid	Replace the stop solenoid
	Faulty starter switch	Replace starter switch
Low cylinder compression	Burned, worn or sticking valves	Replace valves
	Bent valve stem	Replace valves
	Broken or weak valve spring	Replace valve spring
	Blown cylinder head gasket	Replace head gasket
	Worn or sticking piston rings	Replace piston rings
	Scored piston	Replace piston
Poor engine idling	Improper injection timing	Correct the injection timing
	Air in injection pump	Purge air from the system
	Improper governor adjustment	Adjust the governor
Oil pressure warning light fails to operate	Bulb burnt out	Replace the bulb
	Oil pressure sensor is faulty	Replace oil pressure sensor
	Warning light circuit faulty	Replace warning light circuit
Engine knocks	Diluted or thin oil	Change engine oil and filter
	Insufficient oil supply	Check engine oil level
	Low oil pressure	Inspect lube system for restrictions
	Worn crankshaft thrust bearing	Replace thrust bearing
	Excessive flywheel runout	Replace flywheel
	Excessive connecting rod or main bearing clearance	Replace bearings
	Seized bearing	Replace bearing and affected component if necessary
	Clogged oil passage	Clean out oil passages
	Bent or twisted connecting rod	Replace connecting rod
	Crankshaft journals out of round	Rework or replace crankshaft
	Excessive piston to cylinder bore clearance	Replace piston with correct oversized piston
	Excessive piston ring side clearance	Replace piston rings
	Broken or damaged ring	Replace piston ring
	Excessive piston pin clearance	Replace piston pin or bushing

Problem	Possible Cause	Correction
	Seized piston	Replace piston and, if necessary, engine block
	Piston pin retainer loose or missing	Replace retainer
	Improper valve lash adjustment	Adjust valve lash to specification
	Worn valve lifter	Replace valve lifter
	Excessive timing gear backlash	Replace all timing gears
Excessive oil consumption	Engine oil level too high	Remove excess oil
	Leakage in cylinder head gasket	Replace head gasket
	Oil loss past the pistons and rings	Replace piston rings
	Worn, broken, or sticking piston rings	Replace piston rings
	Clogged return hole of oil ring	Unclog return oil hole and replace rings
	Worn valves, guides, or seals	Replace valves, guides, or seals
	Leakage past oil seals and gaskets	Replace leaking seals and gaskets
	External oil leaks from engine	Locate leaks and repair
Engine overheats	Insufficient amount of coolant in the radiator	Fill coolant to proper level
	Hose connection leaking or collapsed hose	Tighten hose connection or replace hose
	Radiator leakage	Locate leak and repair or replace radiator
	Loose, worn, or broken V-belt	Adjust V-belt tension or replace belt
	Radiator fins bent or clogged	Straighten out and clean fins
	Radiator cap not sealing	Replace radiator cap
	Thermostat operating improperly	Replace thermostat cap
	Insufficient amount of oil	Fill to proper level
	Water pump operating improperly	Replace water pump
	Improper valve clearance	Adjust valve clearance to specification
	Restriction in exhaust system	Remove restriction
	Improperly installed cylinder head gasket	Reinstall head gasket in proper position
	Rust and/or scale clogged water ports	Backflush cooling system
	Extended engine idling	Shutdown engine during extended idling periods
Temperature gauge fails to reach normal operating temperature	Faulty temperature sender	Replace temperature switch
	Faulty thermostat	Replace thermostat
	Faulty temperature gauge	Replace temperature gauge
Engine does not start	Faulty starter switch	Replace switch
	Insufficient charging or complete discharge of battery	Check battery and charging system
	Lack of fuel	Fill fuel tank
	Air mixed in fuel system	Inspect fuel system for tightness
	Clogged fuel filter	Replace fuel filter
	Irregular or faulty fuel supply	Replace fuel supply
	Glow plug not heating	Replace glow plug
	Improper lubricating oil viscosity	Replace lube oil
	Clogged air cleaner	Replace air cleaner
	Faulty engine stop solenoid	Replace solenoid
	Burned out fuse	Replace fuse
Excessive Exhaust Smoke	Air cleaner dirty or restricted	Replace air cleaner
	Excessive fuel delivery	Adjust fuel delivery
Engine stops while operating	Lack of fuel in fuel tank	Fill fuel tank
	Clogged fuel filter	Replace filter
	Air mixed in fuel system	Inspect for air leaks
	Faulty engine stop solenoid	Replace solenoid
	Burned out fuse	Replace fuse
Undesirable exhaust color (black or light grey)	Unsuitable fuel	Replace fuel
	Excess injection	Adjust injection
	Faulty engine component	Replace as required

Problem	Possible Cause	Correction
	Over loading	Decrease load
	Clogged air filter	Replace filter
Undesirable exhaust smoke (white or pale)	Excess engine oil	Drain oil to proper oil level
	Improper lubricating oil viscosity	Replace oil with specified viscosity
	Faulty injection timing	Adjust injection timing

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ENGINE AND PTO IN - B

FUEL AND INJECTION SYSTEM - 20.A

Workmaster 45
Workmaster 55

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FUEL AND INJECTION SYSTEM - 20.A

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FUEL AND INJECTION SYSTEM - General specification

INJECTION PUMP	WORKMASTER 45 (N844L)	WORKMASTER 55 (N844LT)
Pump Manufacturer Assembly Number	BASC 104134- 4030	BASC 104135- 4020
Type	In-Line	In-Line
Timing (Before TDC)	**19 - 21 °C**	**19 - 21 °C**
Timing (Piston Height at Injection: Start BTDC)	**3.199 - 3.895 mm** (**0.1259 - 0.1533 in**)	**2.854 - 3.554 mm** (**0.1124 - 0.1399 in**)
Injection Nozzle		
• Nozzle Type	Throttle	Throttle
• Needle Valve Diameter	**0.4 mm** (**0.0157 in**)	**0.4 mm** (**0.0157 in**)
• Pintle Diameter	**1 mm** (**0.039 in**)	**1 mm** (**0.039 in**)
Injection Pressure	**14824 kPa** (**2150 psi**)	**14824 kPa** (**2150 psi**)
Spray Angle	4°	4°
Service Adjustments		
• Idle Speed	**1000 - 1100 RPM**	**1000 - 1100 RPM**
• Max. No-Load Speed	**2815 - 2855 RPM**	**2815 - 2855 RPM**

*BASC - Bosch Automotive Systems Corporation

FUEL AND INJECTION SYSTEM - Special tools

Tool Description	Tool No.
Injector Tester	FNH01721
Injector Adapter Set	FNH01728

Fuel injection pump - Calibration

Standards for adjusting the injection pump

Use the following standards when checking or adjusting the fuel injection pump, or after field rebuilding of the pump.

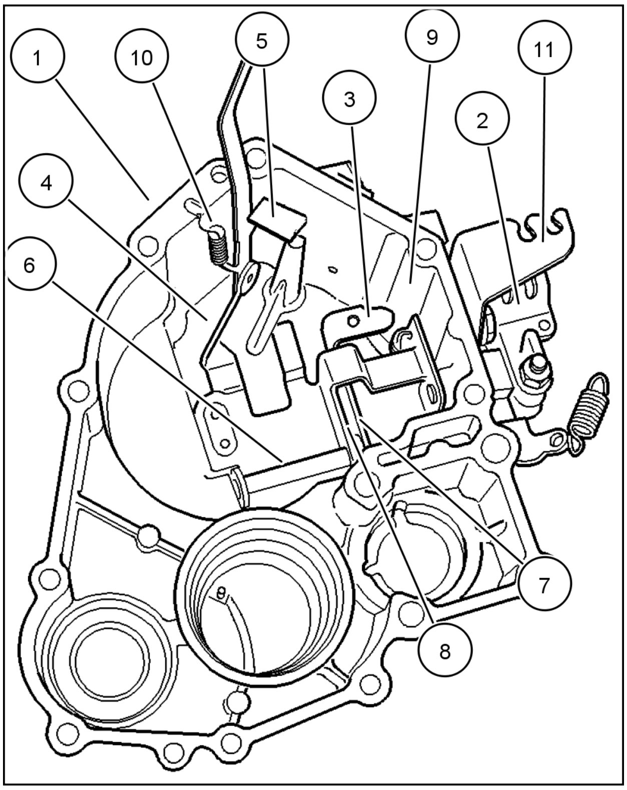
Rotation	Clockwise, viewed from driving side
Nozzle	NP-DN4PDN117
Nozzle Holder	105148-1210
Nozzle Valve Opening Pressure	**14824 kPa** (**2150 psi**)
Injection Pipe	**1.2 mm** (**0.047 in**) inside diameter x **6 mm** (**0.236 in**) outside diameter - **320 mm** (**12.6 in**) long
Oil Flowing Pressure	**19.99 kPa** (**2.9 psi**)
Test Oil	Light Oil

Fuel injection pump - Torque

Torque Specifications	WORKMASTER 45 (N844L)	WORKMASTER 55 (N844LT)
Delivery Valve Holder	**39.2 - 44.1 N·m** (**28.9 - 32.5 lb ft**)	**39.2 - 44.1 N·m** (**28.9 - 32.5 lb ft**)
Injector Assembly	**59 - 69 N·m** (**43 - 51 lb ft**)	**59 - 69 N·m** (**43 - 51 lb ft**)
Injection Pump Retaining Nuts and Bolts	**4.5 - 6.8 N·m** (**3.3 - 5.0 lb ft**)	**4.5 - 6.8 N·m** (**3.3 - 5.0 lb ft**)

Throttle command - Overview Governor

The governor assembly is mounted on the forward end of the camshaft.



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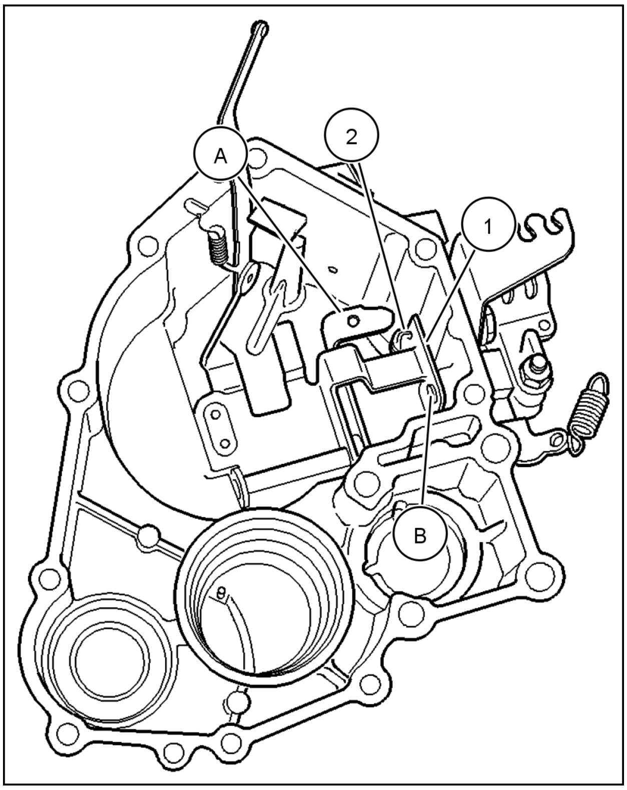
1. Timing Gear Cover	7. Spring Holder
2. Lever	8. Washer
3. Arm	9. Spring
4. Lever	10. Spring
5. Arm Assembly	11. Stay
6. Shaft	

As the engine speed increases, the throttle arm, **(1)**, contacts the fuel screw adjuster at contact point, **(A)** and the high-speed idle stop screw at, **(B)**. During the engine speed increase, tension is placed on the governor spring, **(2)**.



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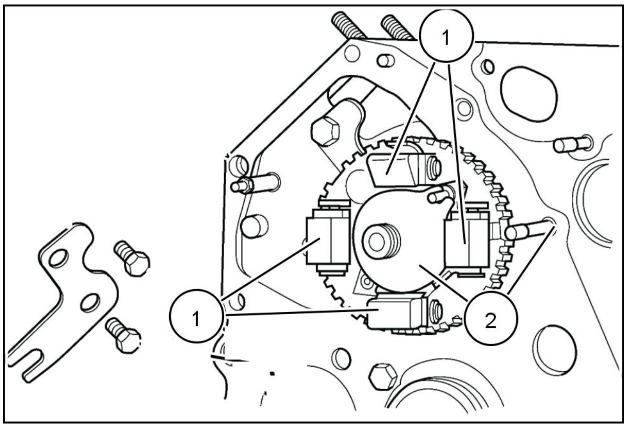
As the engine speed increases the four governor weights, **(1)**, pivot outward and push the slider cone, **(2)**. The weights and the slider cone are located on the end of the camshaft.



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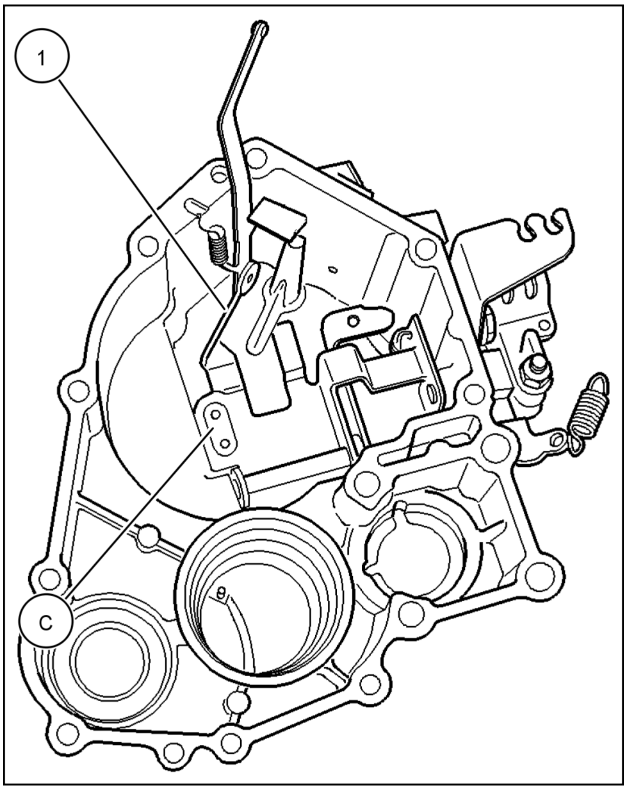
The slider cone, contacts the governor linkage arm, **(1)**, at contact pad, **(C)**. As the cone moves forward it pushes the linkage arm, **(1)**, forward, which is connected to the injection pump rack assembly. When the injection pump rack moves forward the fuel delivery is decreased and the engine speed decreases.



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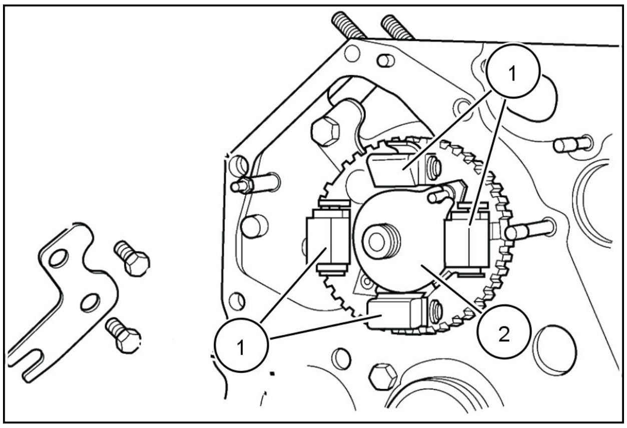
As the engine speed decreases the governor weights, **(1)**, pivot inward allowing the slider cone, **(2)**, to move rearward.



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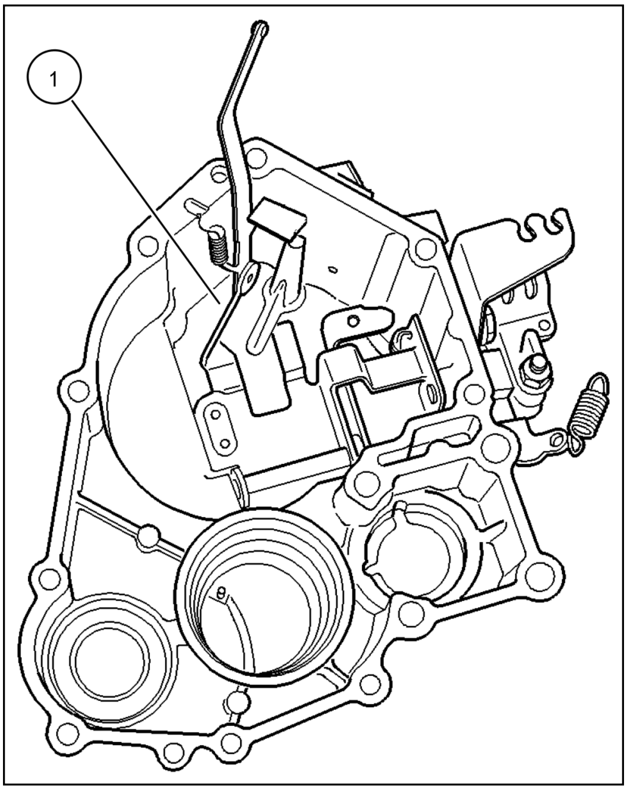
As the slider cone moves rearward, the governor linkage arm, **(1)**, allows the fuel injection pump rack to move rearward to the full fuel position and the engine speed increases.

Engine speed depends upon several factors. The throttle setting determined by governor spring tension. The pressure exerted by the slider cone on the governor linkage, and positioning of the injection pump rack.

All governor linkage parts are located inside the timing gear cover. To inspect or replace any of the governor linkage parts, the timing gear case and the injection pump must be removed from the engine as discussed earlier in this section.



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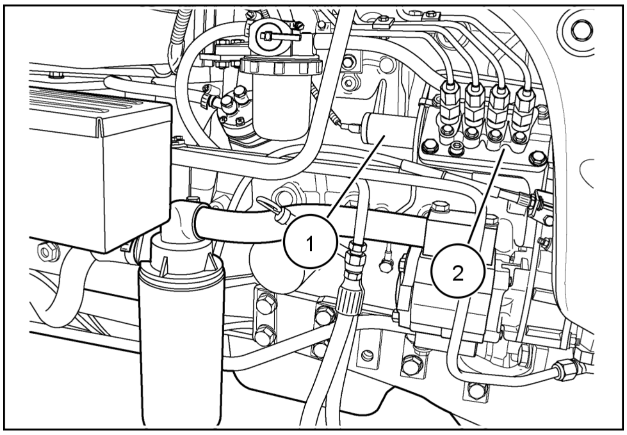
Fuel shut-off - Dynamic description Solenoid

The fuel shutoff solenoid, **(1)**, is located on the right side of the engine, threaded into the rear of the fuel injection pump, **(2)**. The fuel shutoff solenoid contains a spring-loaded plunger that pushes the injection pump control rack to the closed (shut-off) position when the solenoid is not energized. When the key switch is turned to the "ACC/RUN" or "START" position, the safety stop relay closes completing the circuit that energizes the solenoid. This retracts the plunger from the injection pump, and the injection pump control rack moves into the position that allows the engine to start.



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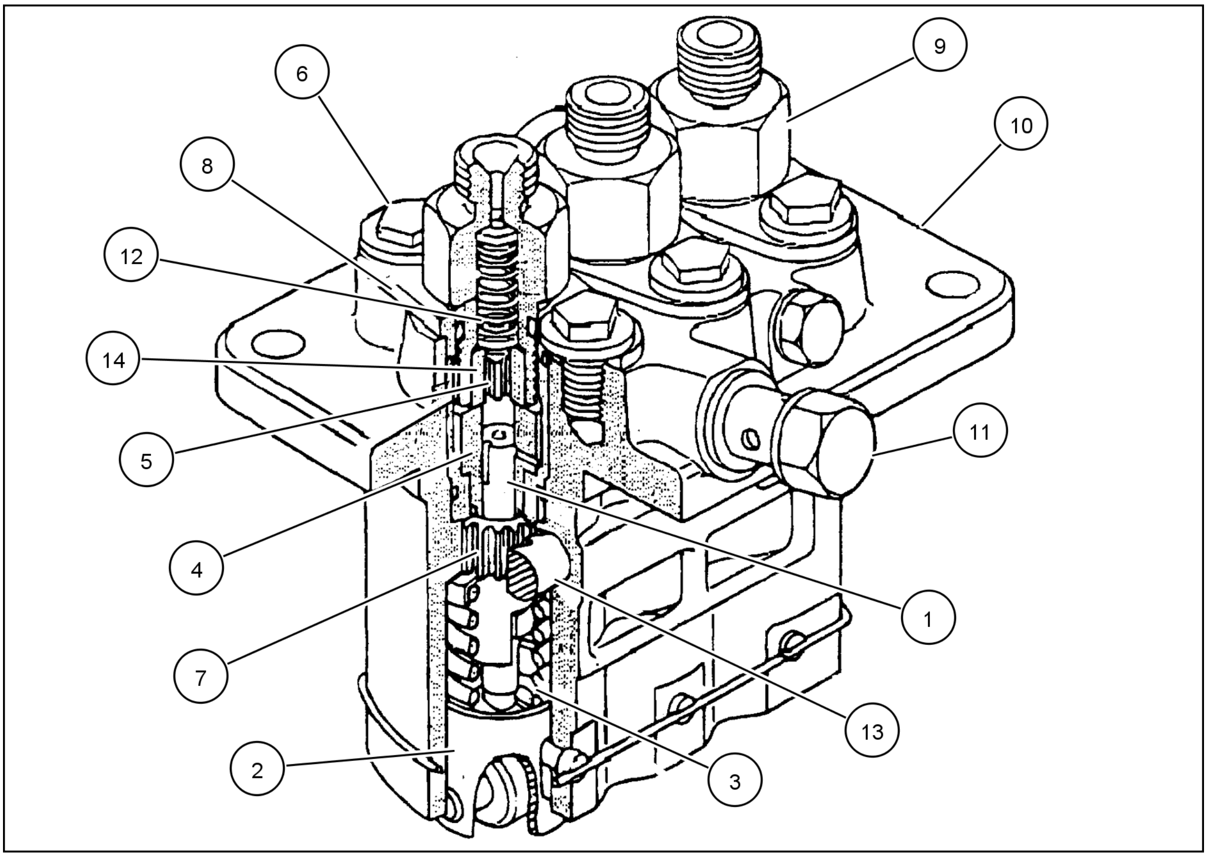
Fuel injection pump - Dynamic description



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1.	Plunger	6.	Five-Sided Bolt	11.	Eye Bolt
2.	Tappet	7.	Control Sleeve	12.	Delivery Valve Spring
3.	Plunger Spring	8.	Sleeve Flange	13.	Control Rack
4.	Plunger Barrel	9.	Delivery Valve Holder	14.	Delivery Valve Seat
5.	Delivery Valve	10.	Pump Housing		

INJECTION PUMP

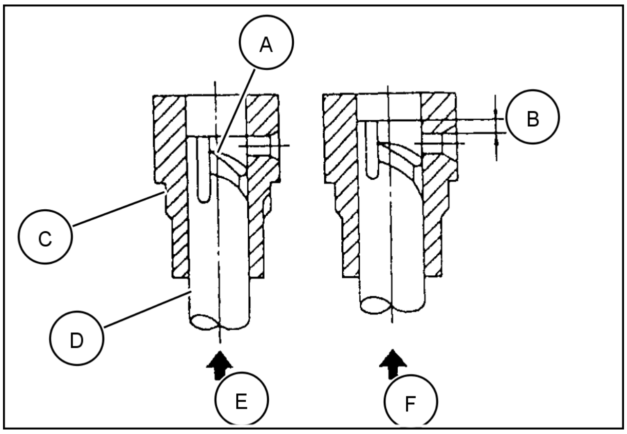
The injection pump is mounted in the engine's cylinder block. It does not have a camshaft, but is driven by the engine's camshaft. Plunger, **(1)**, movement is constant, being raised by tappet, **(2)**, and returned by the plunger spring, **(3)**, as the engine rotates. The plunger barrel's, **(4)**, suction and discharge port opens onto the pump housing's fuel oil chamber, which is always filled with fuel.

When the plunger descends, fuel oil is sucked into the plunger barrel, and when the plunger reaches it's lowest point, the suction of fuel oil stops.

The plunger then ascends, and when the plunger barrel's suction and discharge port is closed by the plunger, the fuel oil pressure increases. The fuel oil then raises the delivery valve, **(5)**, and is delivered through the injection pipe to the nozzle holder. When the fuel oil pressure exceeds the force of the nozzle spring's set force, fuel is injected into the engine's combustion chamber in the form of a fine spray.

The plunger further ascends, and when the plunger helix meets the plunger barrel's suction and discharge port, fuel delivery ends (at the same time injection from the nozzle ends). The delivery valve is then closed by the set force of the delivery valve spring so that fuel oil is no longer delivered, even though the plunger continues to ascend.

The effective stroke is from the moment that the plunger barrel's suction and discharge port is closed by the end of the plunger (beginning-of-injection) until the suction and discharge port meets the plunger helix (end-of-injection). The effective stroke can be altered by rotating the plunger. Accordingly, the relationship between injection quantity and effective stroke is proportional.



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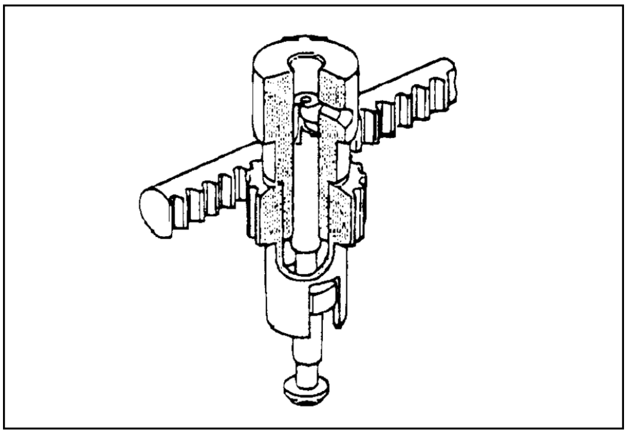
A -	Helix	D -	Plunger
B -	Effective Stroke	E -	Delivery Starts
C -	Plunger barrel	F -	Delivery Ends

Fuel injection pump - Dynamic description Fuel variation mechanism

As well as pressurizing the fuel oil, the injection pump also functions to vary the fuel injection quantity.

A control sleeve is installed around the plunger barrel, and a flange on the bottom of the plunger is inserted into a groove in the control sleeve. Teeth on the control sleeve are engaged with teeth on the control rack so that movement of the control rack results in rotation of the plunger and, consequently, variation of the fuel injection quantity.



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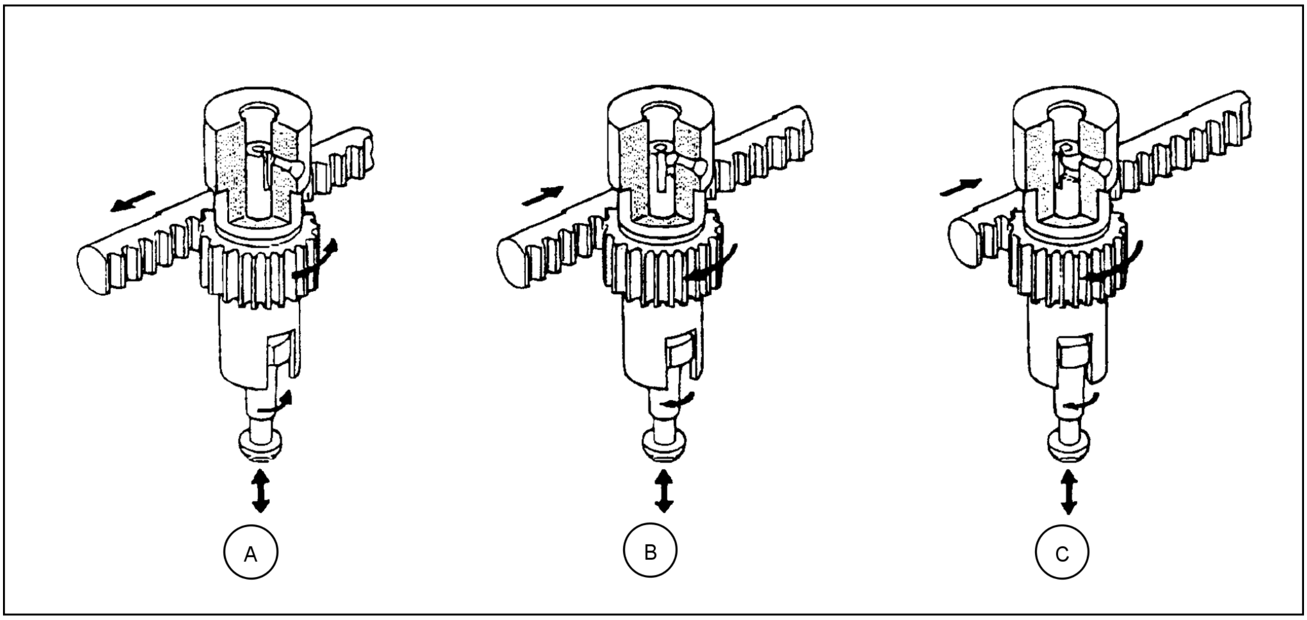

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A - Non Delivery
B - Partial Delivery
C - Maximum Delivery

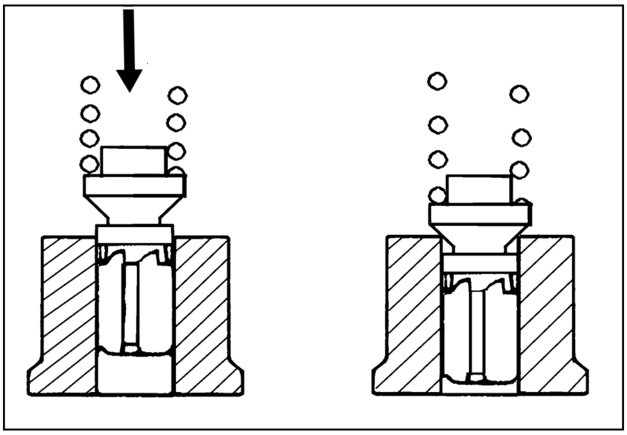
Fuel injection pump - Dynamic description (Delivery Valve Assembly)

The delivery valve assembly consists of the delivery valve and the valve seat.

When the force of the high-pressure fuel oil delivered by the plunger exceeds the force of the delivery valve spring, the delivery valve opens and fuel oil is delivered through the injection pipe to the nozzle holder.

After injection, the injection pipe retains a degree of residual pressure adequate for the subsequent injection. The delivery valve prevents the reverse flow of this fuel oil in the injection pipe to the plunger side. If the residual pressure is too high, then the flow of fuel oil will not be properly cut after injection.

By allowing the fuel oil in the injection pipe to retract an amount equal to the piston’s retraction stroke, the delivery valve improves the ability of the nozzle to cut injection, as well as preventing dribbling.



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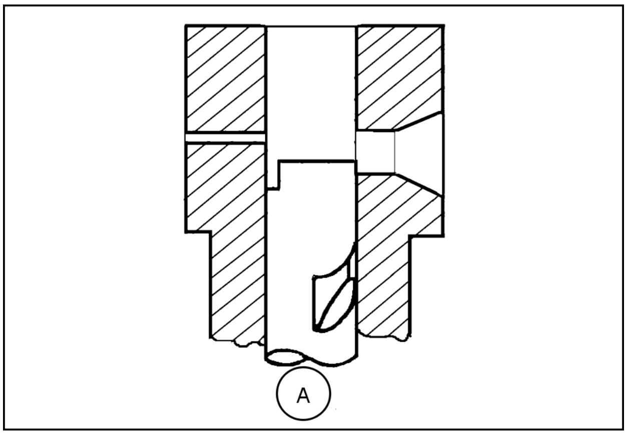
Fuel injection pump - Dynamic description (Compact Timing Device Mechanism)

NOTE: *The CTD (Compact Timing Device) mechanism is installed on the tractors to reduce noise, smoke, and exhaust gas emission etc.*

When the plunger descends, fuel oil is sucked into the barrel, and when the plunger reaches its lowest point, the suction is finished.



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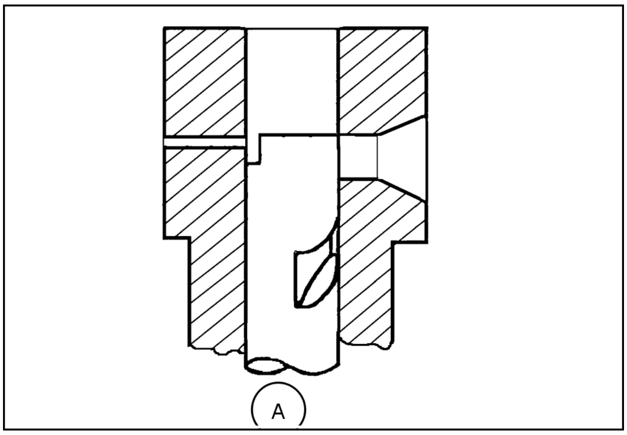
(A) Suction

In case of the standard plunger, the plunger then ascends, and when the barrel's main port is closed by the plunger, the fuel oil pressure increases, and the fuel delivery starts.

CTD type plunger (the barrel has sub port), whether the fuel delivery starts or not is determined by the en- gine's rev speed. When the engine's rev speed is low, the delivery does not start, because the sub port is still opened, and fuel oil pressure does not increase. But, when the engine's rev speed is high, the sub port's diameter is so small that it can be considered as being closed. For this reason, fuel oil pressure increases and the delivery starts.



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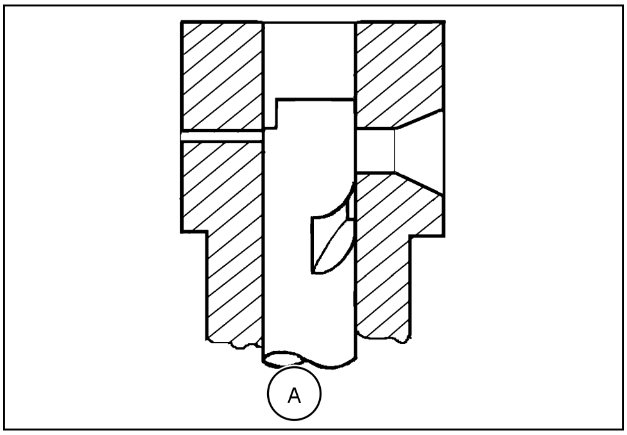
(A) Delivery Start (High Speed)

The plunger further ascends, and when the barrel's sub port is closed by the plunger, the fuel oil pressure increases and the delivery starts, regardless of the engine's rev speed.



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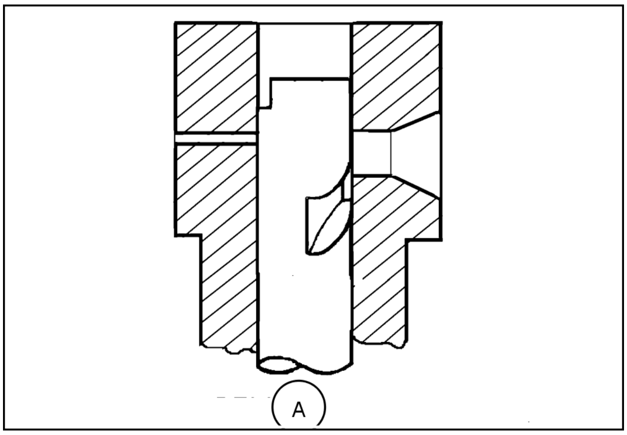
(A) Delivery Start (Low Speed)

The plunger further more ascends, and when the plunger main lead meets the barrel’s main port, the fuel oil pressure decreases, and the fuel delivery ends.



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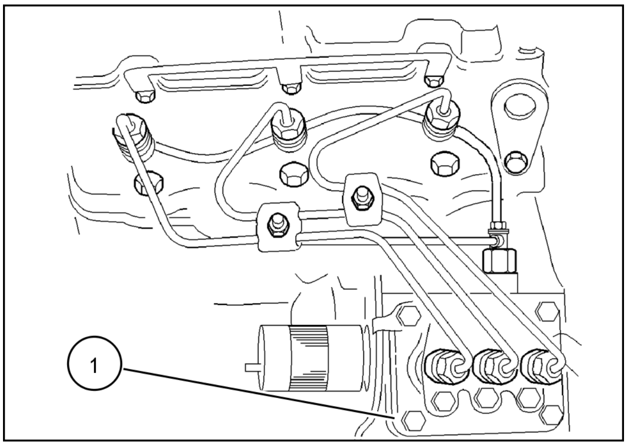
(A) Delivery End

The fuel injection pump **(1)**, is a constant stroke type pump and has one pumping element for each cylinder. The injection pump operates at one-half engine speed.



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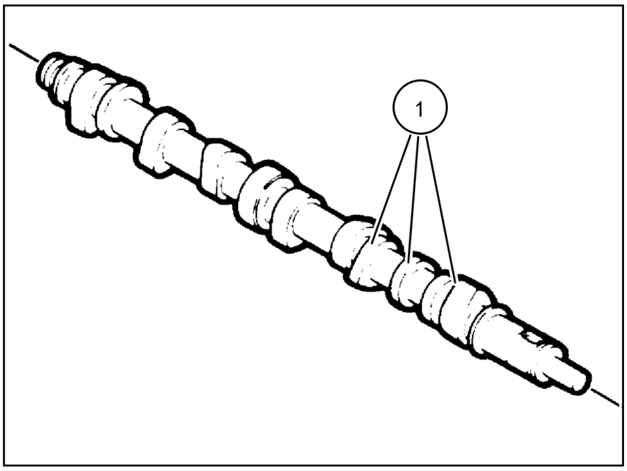
Fuel injection pump - Dynamic description Pumping Elements

The pumping elements are operated by cam lobes **(1)**, that are incorporated on the engine valve train camshaft, which is driven by the engine oil pump.



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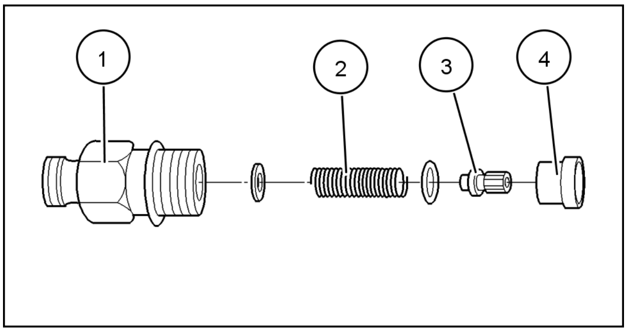
Fuel injection pump - Dynamic description Delivery Valves

Located above each pumping element is a delivery valve assembly. The delivery valve consists of a delivery valve holder **(1)**, spring **(2)**, piston and stem assembly **(3)**, operating within a cylindrical guide **(4)**, which terminates in a conical seat. The lower part of the stem has four vertical flutes which accurately locate within the guide while permitting fuel to pass. Above the flutes is a piston which is a lapped fit in the bore of the valve guide.



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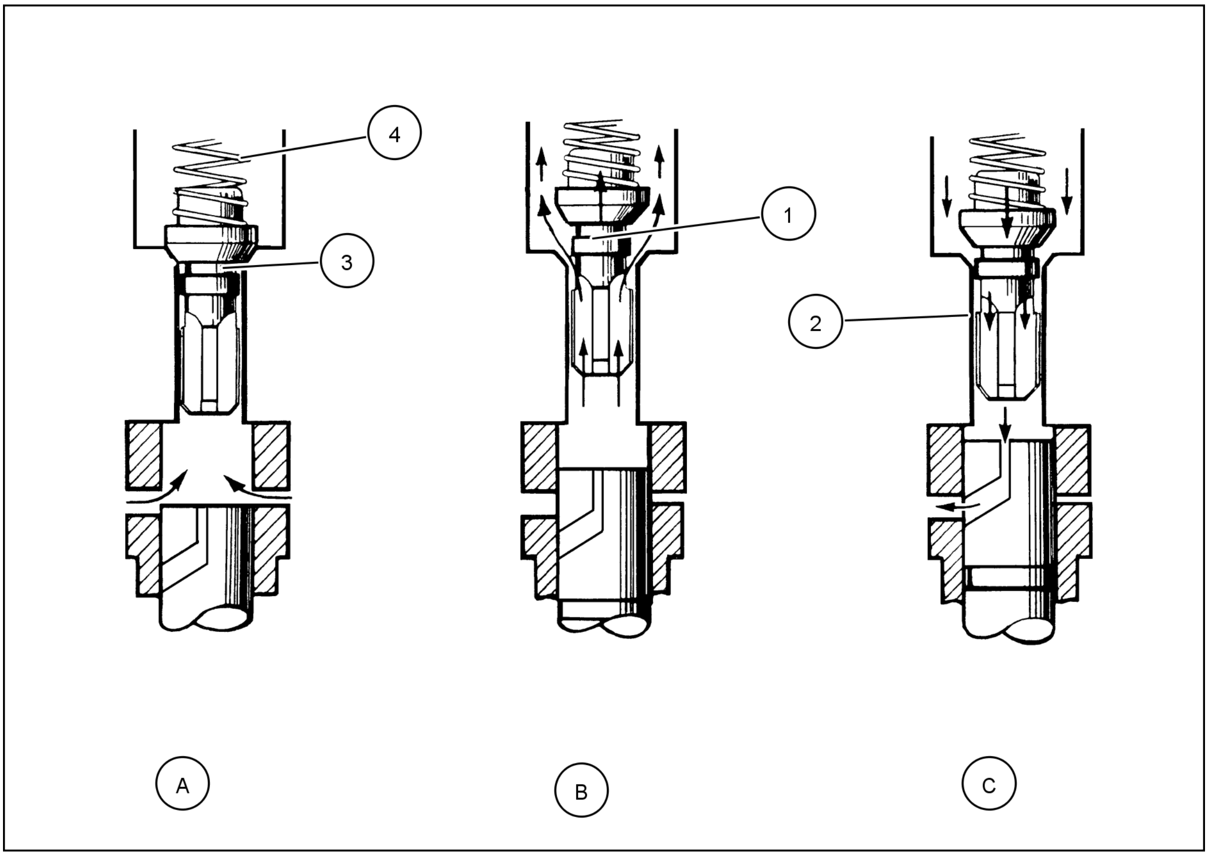
The delivery valve serves as a non-return valve and also as a means of rapidly reducing the fuel pressure in the injector line when injection ceases. Rapid pressure reduction is required to be sure injector needle valve "snaps" shut to prevent fuel "dribble", a condition which can cause carbon formation on the injector tip.



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(1) Piston

(2) Valve Guide

(A) Valve Closed

(C) Valve Closing

(3) Conical Seat

(4) Spring

(B) Valve Open

The delivery valve operates as follows:

Position A:

The pump plunger is at the bottom of the stroke and the inlet ports are uncovered, so the barrel and delivery guides are filled with fuel. As the fuel is at low pressure, the delivery valve is retained on the seat by spring pressure.

Position B:

The plunger has risen and closed both inlet ports, pressurized the fuel and the injection process begins. The pressurized fuel overcomes the spring tension, lifting the delivery valve off its seat until the piston is clear of the guide, permitting fuel to pass to the injector.

Position C:

The helical groove has uncovered the inlet port and released the fuel pressure. The delivery valve spring, aided by the high pressure still existing in the pipeline, forces the delivery valve to close rapidly.

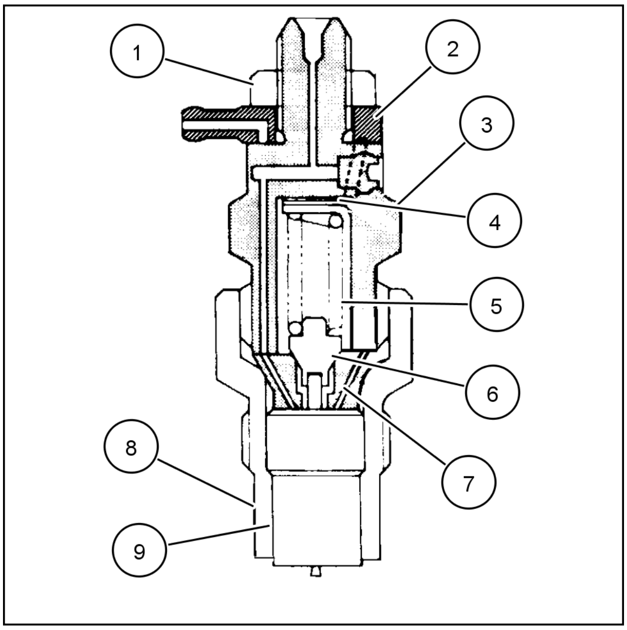
During closing, the piston portion of the valve returning into the guide increases the volume of the injector line by the volume of this part of the valve.

This sudden increase in the volume of the injector line causes a rapid collapse of pressure and allows the injector needle valve to "snap" shut.

Fuel injector - Dynamic description

Throttle-type injectors are used in all engine applications. The injectors have a **1.0 mm** (**0.04 in**) single orifice and are set at **14824 kPa** (**2150 psi**). The pressure adjustment is made by adding or deleting shims from the top of the injector pressure adjusting spring. The injectors have an injection angle of **4 °**. The injector pipes are of the same length for each cylinder to help keep the injection intervals in time.

The engine injection function is to inject fuel into a pressurized cylinder in a fully atomized condition, which provides efficient combustion with minimum amount of smoke. Each injector assembly consists of a nozzle assembly containing a needle valve, a nozzle holder assembly, and injector needle valve regulating spring.



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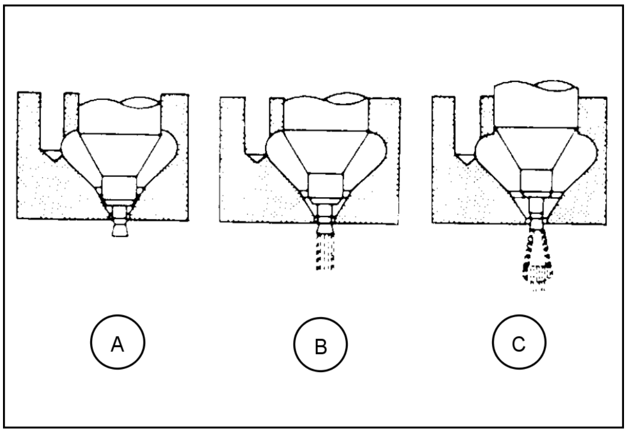
1. Nut
2. Nipple Joint
3. Body
4. Shim
5. Spring
6. Push Rod
7. Distance Piece
8. Nozzle Nut
9. Nozzle Assembly

Fuel from the injection pump enters the injector inlet and passes down through a drilling in the nozzle holder and body to the needle valve seat. The fuel pressurized by the injection pump, lifts the needle valve off the seat against the action of the spring pressure. The fuel is then forced, in the atomized state, through the **1.0 mm** (**0.04 in**) orifice in the nozzle tip. When pressure from the injection pump drops, the needle valve snaps back onto its seat under pressure from the spring.

To provide lubrication of the injector, a small amount of fuel is permitted to leak up between the needle valve and the nozzle body. The excess fuel rises to the top of the injector and returns to the fuel tank through the injection leak-offline.

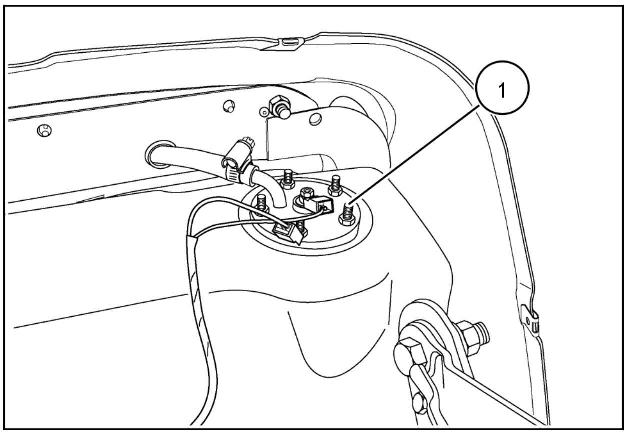


20097770 2

A. Nozzle Closed
B. Nozzle Initial Opening
C. Nozzle Fully Opened

Sensing system - Static description Fuel level sender

The fuel level sender, **(1)**, is mounted on the top of the inside of the fuel tank. The sender float moves up and down with the fuel level in the tank, while changing the resistance to the ground circuit of the fuel gauge.



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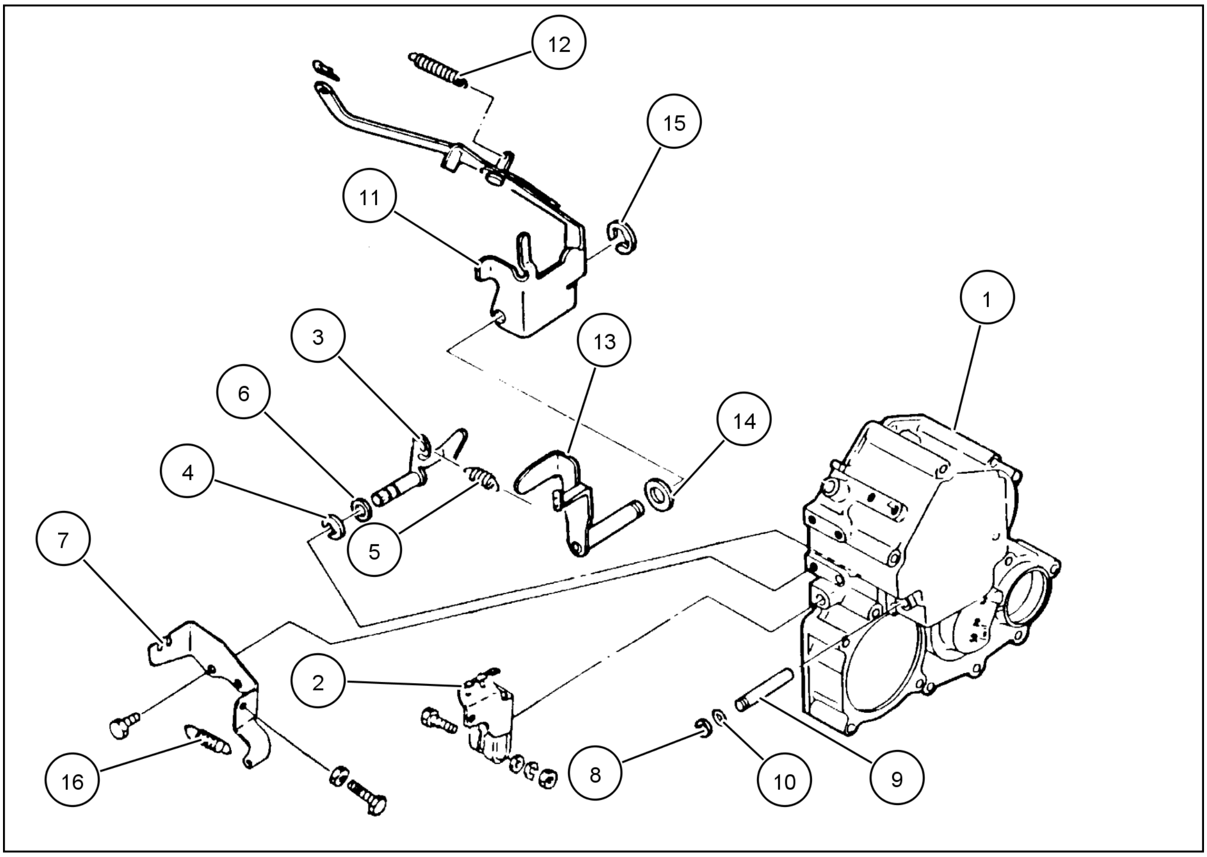
Throttle command - Disassemble Governor



20097766 1

1. Timing Gear Cover	7. Throttle Cable Stay	13. Spring Holder Arm
2. Throttle Lever	8. E Ring	14. Washer
3. Throttle Arm	9. Pivot Shaft	15. E Ring
4. E Ring	10. O-Ring	16. Spring
5. Governor Spring	11. Linkage Arm Assembly	
6. E-ring	12. Dampener Spring	

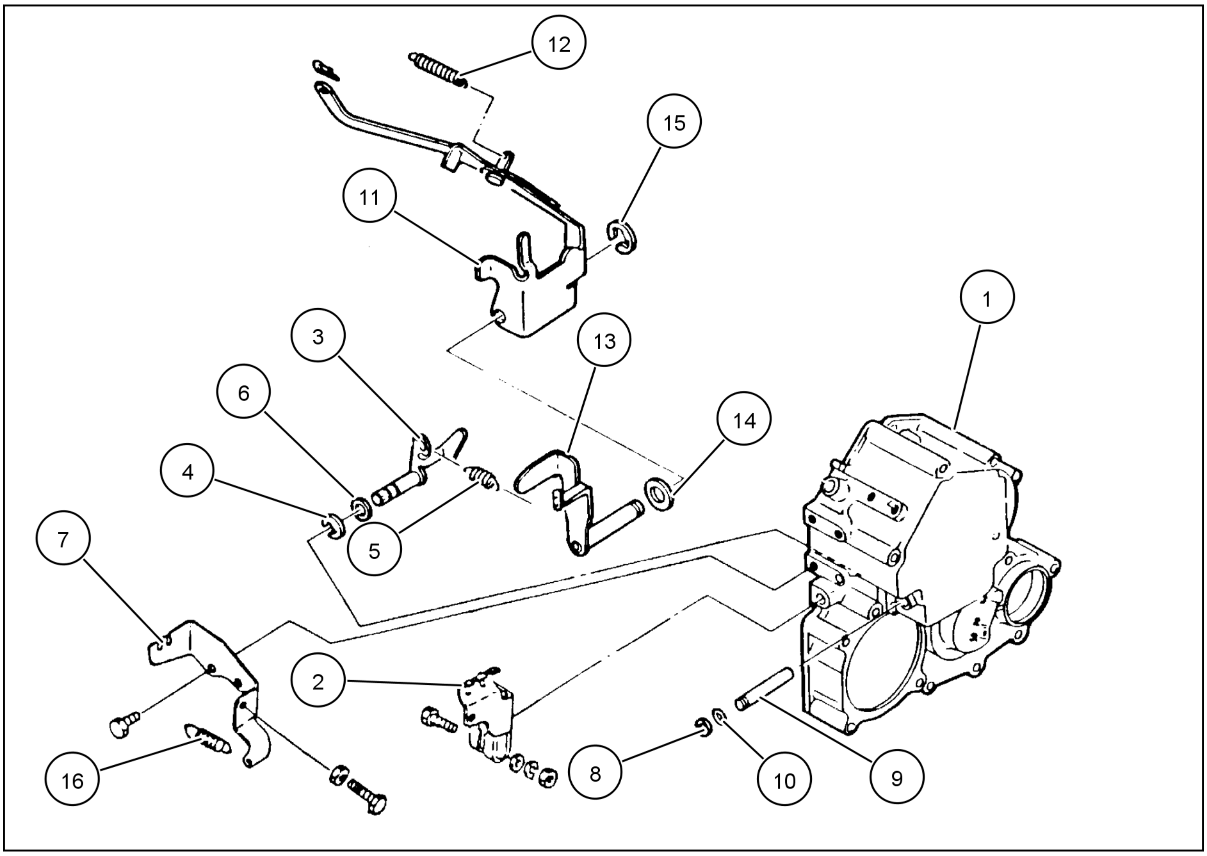
1. Remove the injection pump and timing gear case from the engine. Refer to **Fuel injection pump - Remove (B.20.A)**.
2. Remove the timing case, **(1)**, from the front of the engine. Remove the throttle lever, **(2)**, from the outside end of throttle arm, **(3)**.
3. Remove the E-ring, **(4)**, from throttle arm, **(3)**. Push throttle arm into the timing case until there is enough space to remove governor spring, **(5)**. Remove governor spring, **(5)**, from throttle arm, **(3)**. Remove throttle arm from timing case. Inspect O-ring, **(6)**, and replace if damaged.
4. Remove throttle cable stay, **(7)**, from timing gear cover, **(1)**.
5. Remove E-ring, **(8)**, from the outside end of linkage pivot shaft, **(9)**. Pull pivot shaft, **(9)**, out of the timing case. Inspect O-ring, **(10)**, on shaft. Replace if damaged.

6. Remove linkage arm assembly, **(11)**, from the timing case, **(1)**. Remove governor spring, **(5)**, and dampener spring, **(12)**, from the linkage. Check all pivot points, slot, and pin locations for wear. Replace the linkage assembly, **(11)**, if wear is present. Check spring holder arm, **(13)**, making sure it pivots freely. Confirm that spacer, **(14)**, is installed between arm and arm base. Also make sure the E-ring, **(15)**, is installed in the groove of the spring holder arm.

Next operation:
Throttle command - Assemble Governor (B.20.A)

Throttle command - Assemble Governor

Prior operation:
Throttle command - Disassemble Governor (B.20.A)



20097766 1

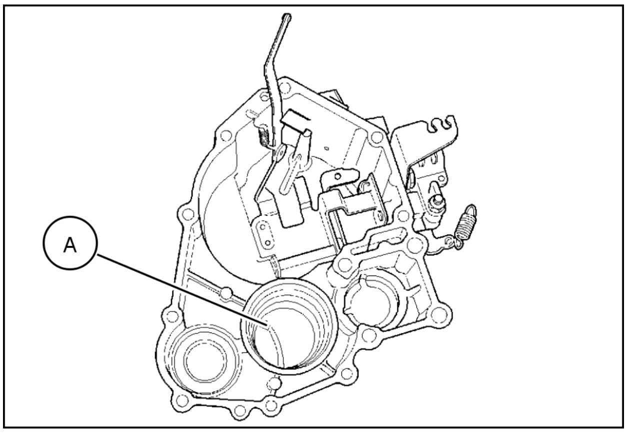
1. Timing Gear Cover
2. Throttle Lever
3. Throttle Arm
4. E Ring
5. Governor Spring
6. O-Ring
7. Throttle Cable Stay
8. E Ring
9. Pivot Shaft
10. O-Ring
11. Linkage Arm Assembly
12. Dampener Spring
13. Spring Holder Arm
14. Washer
15. E Ring
16. Spring

Assembly

1. Install governor spring, **(5)**, onto the throttle arm, **(3)**.

NOTE: *Align pin,* ***(A)****, with oil pump cover when the case is assembled onto the engine.*

NOTE: *Spring is installed onto front spring holder arm with spring inserted from the inside of the arm.*



20097765 2

2. Place linkage arm assembly, **(11)**, into case.

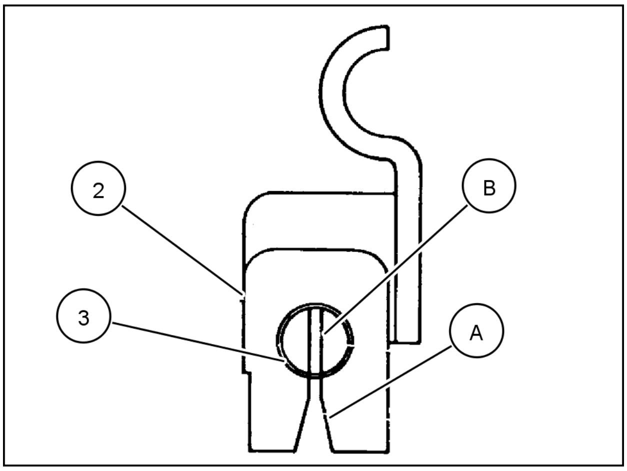
NOTE: *Check that spacer washer,* ***(14)****, is installed between spring holder arm and base and E-ring,* ***(15)****, is installed into groove of spring holder arm,* ***(13)****.*

The shaft is oriented with tapered end towards outside of the case. With O-ring, **(10)**, installed and the shaft lubricated, insert pivot shaft, **(9)**, into case. Install shaft through linkage arm assembly, **(11)**, until O-ring is in the case, **(1)**. Install E-ring, **(8)**, onto shaft, then push shaft into case until E-ring touches case.

3. Install throttle arm, **(3)**, with O-ring, **(6)**, from the inside of the case, until the O-ring engages into the case. Install other end of governor spring, **(5)**, into the slotted hole of the throttle arm. Once the spring is installed, push the rest of the throttle arm into the case. Insert E-ring, **(4)**, into the groove of the throttle arm.

4. Install the throttle cable stay, **(7)**, onto the timing gear cover, **(1)**. Install throttle lever, **(2)**, onto throttle arm, **(3)**. Align the slot, **(A)** in the throttle lever with groove, **(B)** of the throttle arm. Retain lever to arm by tightening clamp bolt and nut. After the clamp bolt is tightened, pivot throttle lever back and forth to check if all the linkage pivots freely. Install throttle return spring, **(16)**, to throttle lever **(2)**, and stay, **(7)**.

NOTE: *The aligning of the slot in the lever with the groove in the arm properly indexes the lever and attaching cables to the internal linkage.*

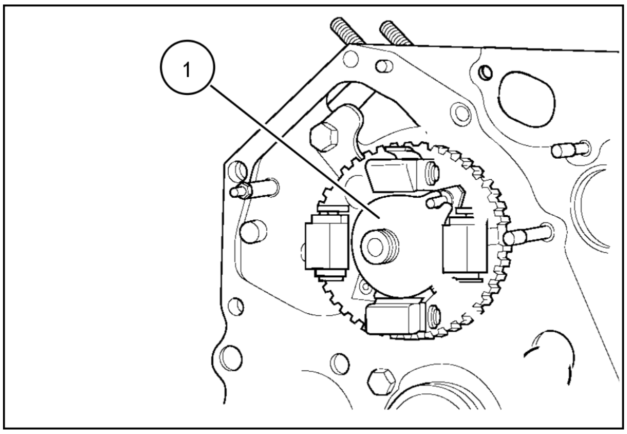


20096952 3

5. Install the dampener spring, **(12)**, onto linkage arm assembly and timing case. The long leg of the spring is inserted into the timing case.

NOTE: *When installing timing case onto engine block, make sure dampener spring stays in retaining hole of case. Also, have the manual shutoff lever located on the backside of the linkage arm assembly.*

6. Check that nose cone, **(1)**, slides freely on the end of camshaft and guide pin. Lubricate nose cone with never seize compound.



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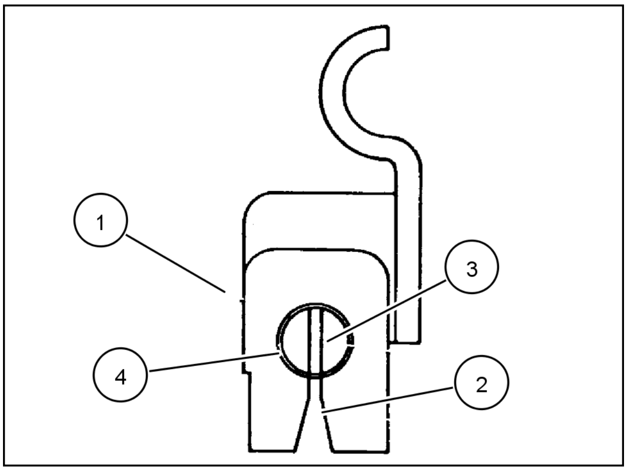
Next operation:
Throttle command - Adjust Governor (B.20.A)

Throttle command - Adjust Governor

Prior operation:
Throttle command - Assemble Governor (B.20.A)

The governor assembly is mounted on the forward end of the engine block. To remove and install the governor assembly, see "Engine Timing Gear Cover, Timing Gears, and Cam Shaft", discussed earlier in this section.
If the governor linkage has been disassembled, reassemble the linkage in the timing gear cover as discussed earlier in this section.



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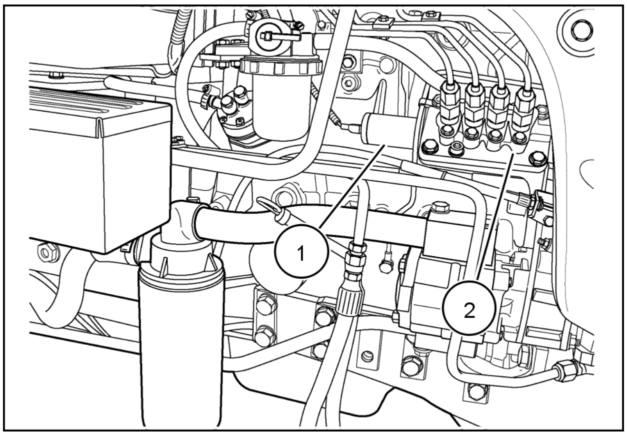
1. Adjust the governor lever **(1)**, by aligning the slot **(2)**, in the lever with the groove, 3, in the governor arm **(4)**.

Next operation:
Fuel injector - Dynamic description (B.20.A)

Fuel shut-off - Remove Solenoid

1. Disconnect the negative (−) battery cable from the battery
2. Disconnect the wiring harness lead from the fuel shutoff solenoid, **(1)**.
3. Using a pair of pliers, carefully remove the fuel shut-off solenoid, **(1)**, from the fuel injection pump, **(2)**.



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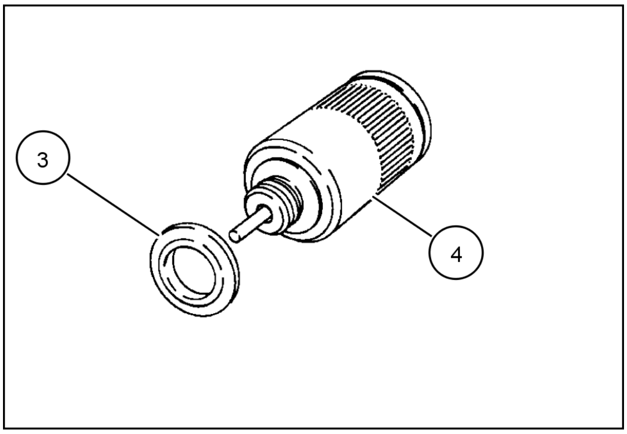
4. Remove and discard the sealing washer, **(3)**, which seals the solenoid, **(4)**, to the fuel injection pump.



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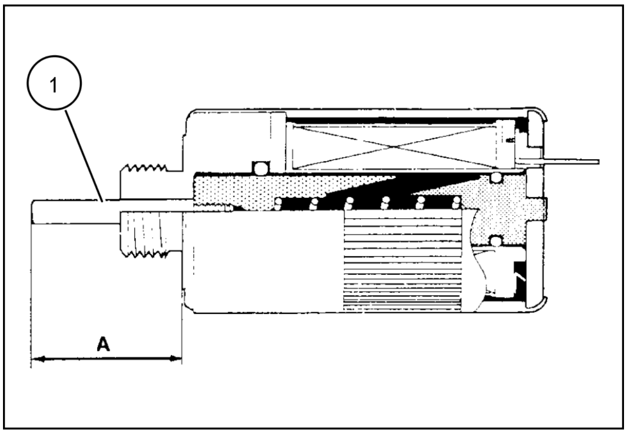
Next operation:
Fuel shut-off - Test Solenoid (B.20.A)

Fuel shut-off - Test Solenoid

Prior operation:
Fuel shut-off - Remove Solenoid (B.20.A)

1. Using a suitable measuring device, measure the actuating pin, **(1)**, protrusion distance, "A", on the solenoid. The distance should measure between **25.5 - 26.4 mm** (**1.004 - 1.039 in**). If the distance is not within these specifications, the solenoid is defective and needs replaced.



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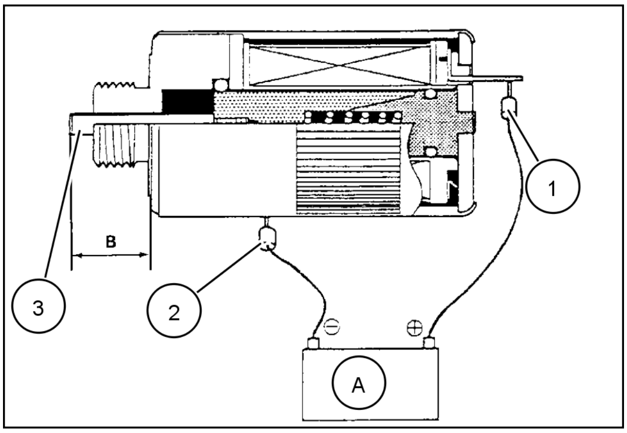
NOTE: *When connecting the* ***12 V*** *power supply to the solenoid body, be sure paint is the removed from the body. Otherwise, the power will not be transferred to the solenoid.*



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A - BATTERY

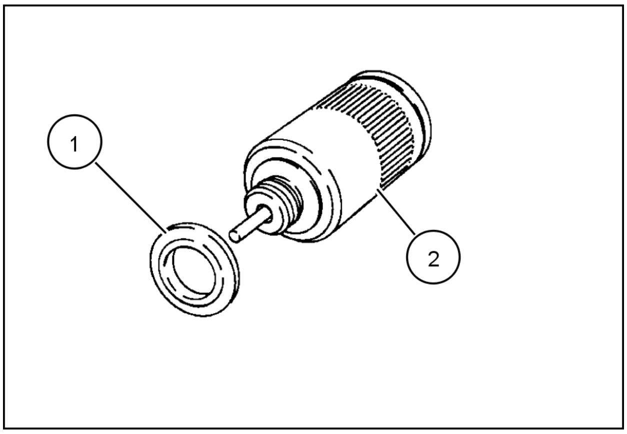
2. Use jumper wires to connect the positive (+) terminal of a **12 V** power supply to the solenoid lead, **(1)**. Connect the negative terminal of the **12 V** power supply to the solenoid body, **(2)**. The plunger should retract into the solenoid body.
3. Using a suitable measuring device, measure the actuating pin, **(3)**, protrusion distance, "B" on the solenoid. The distance should measure between **11.5 - 14.5 mm** (**0.453 - 0.571 in**). If the distance is not within these specifications or the plunger does not retract, the solenoid is defective and needs replaced.

Next operation:
Fuel shut-off - Install Solenoid (B.20.A)

Fuel shut-off - Install Solenoid

Prior operation:
Fuel shut-off - Test Solenoid (B.20.A)

1. Install a new sealing washer, **(1)**, on the solenoid, **(2)**.



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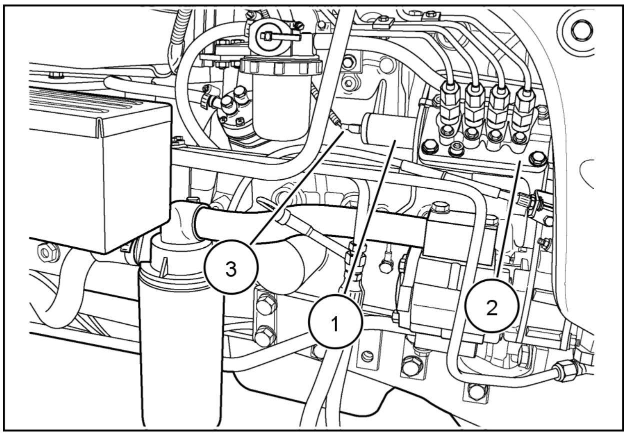
2. Thread the fuel shutoff solenoid, **(1)**, into the fuel injection pump, **(2)**. Use pliers to tighten the solenoid into the injection pump.
3. Connect the wiring harness lead, **(3)**, into the fuel shutoff solenoid, **(1)**.
4. Connect the negative (-) battery cable to the battery.



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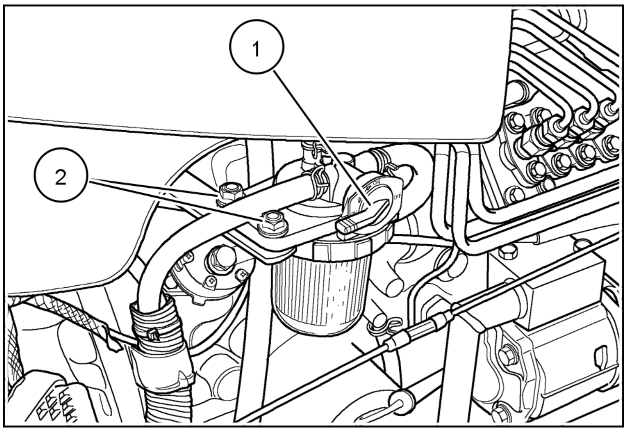
Fuel injection pump - Remove

1. Turn the fuel shut-off valve, **(1)** to the "OFF" opposition.
2. For easier access to the injector line nuts, remove the filter from the bracket by removing the nuts, **(2)**.



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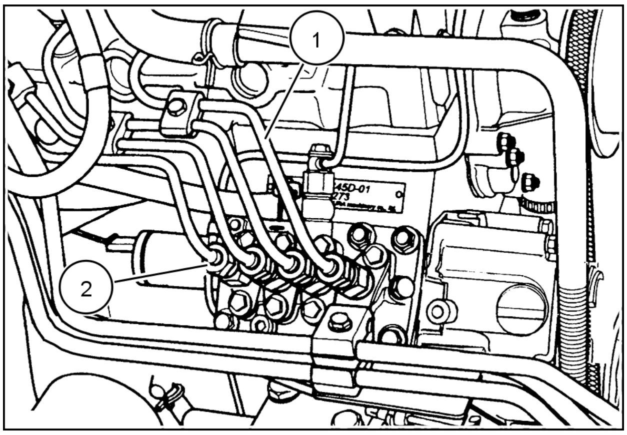
3. Remove the fuel injection lines, **(1)**, by loosening nuts, **(2)**, on the injection pump and the nuts on the injectors.

NOTE: *Cap and plug all openings to prevent contamination.*



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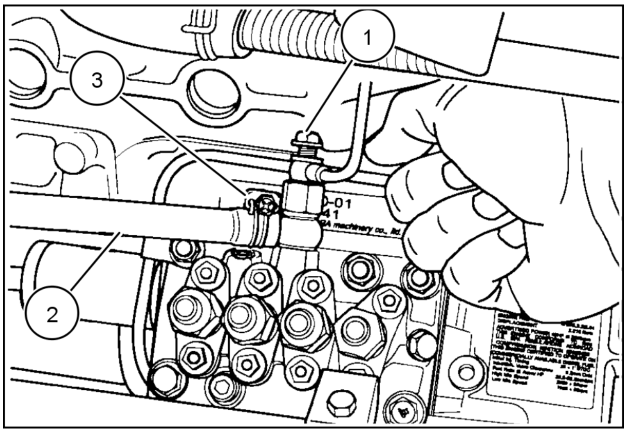
4. Disconnect the fuel tank return line by removing bolt, **(1)**.
5. Disconnect fuel inlet line, **(2)**, by loosening clamp screw, **(3)**.



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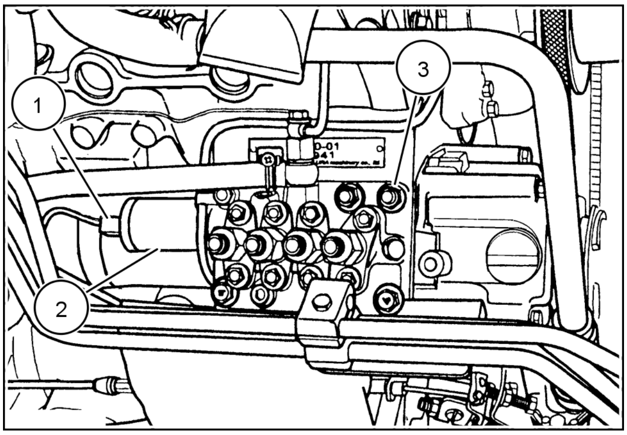
6. Disconnect the wire, **(1)**, to the fuel shut-off solenoid, **(2)**, and remove the fuel shut-off solenoid.
7. Remove the mounting nuts and bolts, **(3)**.



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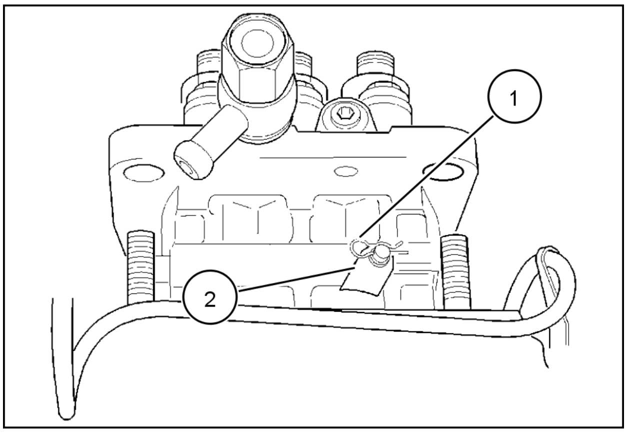
8. Raise the pump and remove the snap pin, **(1)**, and separate the governor link, **(2)**, from the pump control rack, **(3)**, Figure **6**.
9. Remove the injection pump from the engine.

NOTE: *If there are shims between the pump mounting flange and the engine block, carefully remove the shims and retain for installation.*



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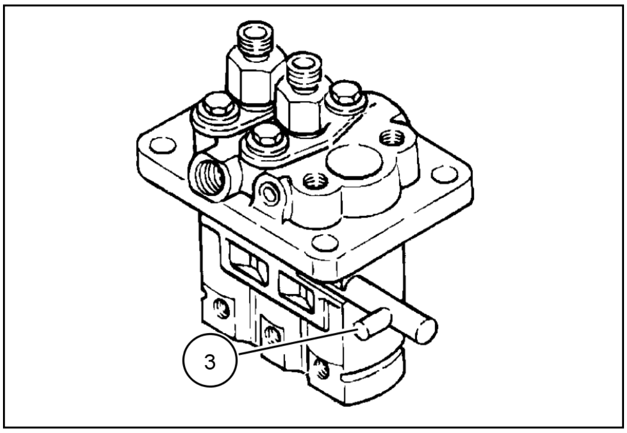

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Repair

If the injection pump is suspected of being faulty, it should be repaired by an authorized Diesel Service Station only.

NOTE: *If repair is within New Holland warranty period, replace injection pump with a new pump from the " New Holland Parts Department".*

Next operation:
Fuel injection pump - Install (B.20.A)

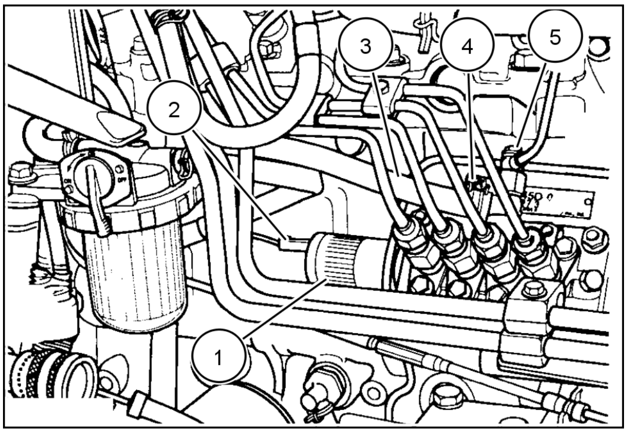
Fuel injection pump - Install

Prior operation:
Fuel injection pump - Remove (B.20.A)

Installation generally follows removal procedures in reverse. If the pump is being replaced or if the timing is unknown, proceed to **Fuel injection pump - Adjust (B.20.A)**.

1. Attach the pump rack to the governor linkage.
2. Install injection pump assembly with shims into engine housing.
3. Install the pump mounting nuts and bolts and tighten to **13 - 17 N·m** (**9.6 - 12.5 lb ft**).
4. Install fuel solenoid, **(1)**, into rear of injector housing and connect the electrical lead, **(2)**.
5. Connect the fuel inlet line, **(3)**, by tightening clamp screw, **(4)**.
6. Install the fuel return line by installing bolt, **(5)**.
7. Install injector lines, **(6)**, by tightening nuts, **(7)**, at the pump and nuts at the injectors.
8. If removed, reinstall the fuel filter onto its bracket by tightening two nuts, **(8)**.
9. Turn the fuel shut-off valve, **(9)**, to the "ON" position.
10. After installation bleed air from the fuel system. See **Fuel injection pump - Bleed Auto (B.20.A)**.

NOTE: *It may be necessary to verify pump timing. Spill-time the pump as outlined in **Fuel injection pump - Timing adjust (B.20.A)**.*



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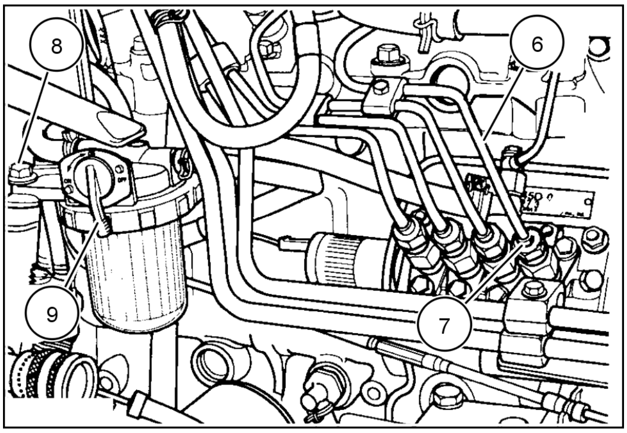

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Next operation:
Fuel injection pump - Adjust / Calibration (B.20.A)

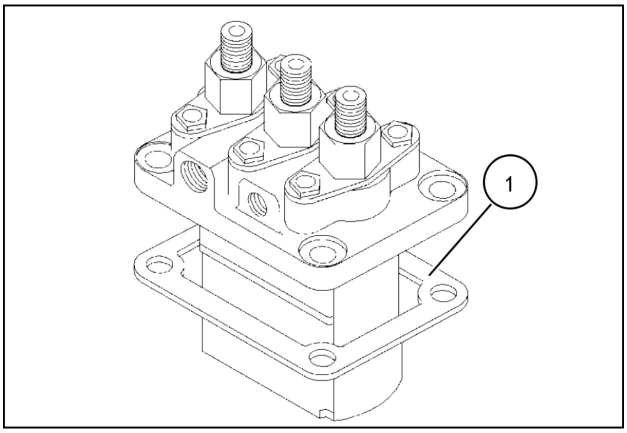
Fuel injection pump - Adjust / Calibration

Prior operation:
Fuel injection pump - Install (B.20.A)

Installation (New Pump or Drive Component)

NOTE: *Installation of a new pump is the same as installation of an original pump. When installing a new pump, however, checking the timing is required.*

1. Position the pump in the block using a new shim gasket, **(1)**, of **0.3 mm** (**0.012 in**) thickness, or original shim pack from removed pump.



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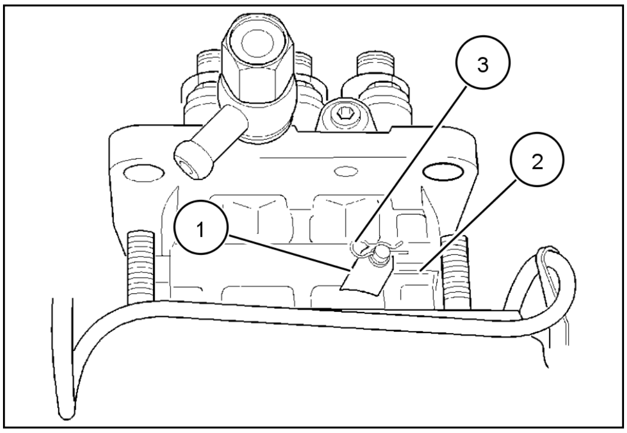
2. Connect the governor link, **(1)**, to the pump control rack, **(2)**, and secure with snap pin, **(3)**.



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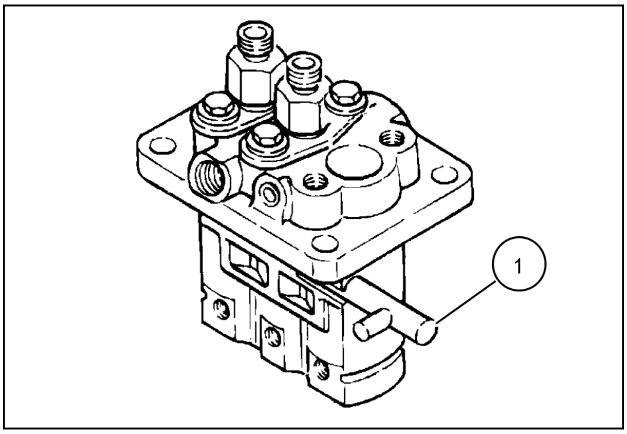
NOTE: *Check the control rack, **(1)**, for any binding conditions by moving the control lever back and forth. Lubricate control rack with clean engine oil before installation.*

3. Install the mounting bolts and tighten to **13 - 17 N·m** (**9.6 - 12.5 lb ft**).
4. Connect the fuel inlet line.
5. Connect the fuel injection lines.
6. Connect the fuel return line to the number four injector.
7. Spill-time the pump.



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Next operation:
Fuel injection pump - Timing adjust Spill-timing procedure (B.20.A)

Fuel injection pump - Timing adjust Spill-timing procedure

Prior operation:
Fuel injection pump - Adjust / Calibration (B.20.A)

NOTE: *There is not an approved procedure available for checking the fuel injection pump timing on a Tier 3 emissionized compact tractor diesel engine. The fuel injection pump timing is set at the factory and cannot be accurately checked or adjusted at a compact tractor dealer service facility.*

If the injection pump is removed or replaced, install the original production shim pack between the injection pump and the engine block mounting surfaces.

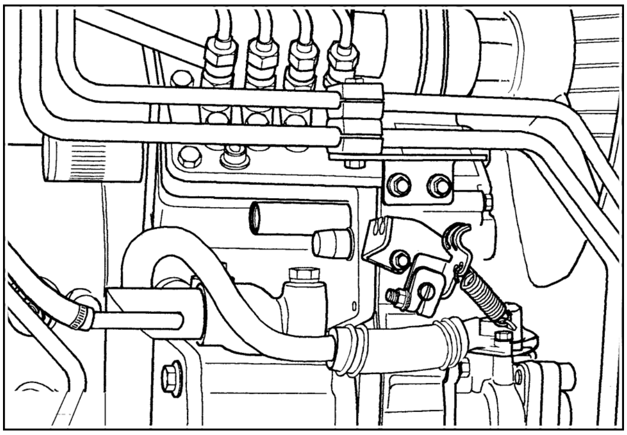
Next operation:
Fuel injection pump - Flow setting Fuel Screw/High Idle Adjustment (B.20.A)

Fuel injection pump - Flow setting Fuel Screw/High Idle Adjustment

Prior operation:
Fuel injection pump - Timing adjust Spill-timing procedure (B.20.A)

The correct adjustment is required to reset to the original production setting to ensure the engine will be within the certified emission limits.

NOTE: *EPA engine is certified to EPA emission legislation.*
No one is permitted to adjust the fuel flow rate more than the maximum figure of submitting for power setting.
Adjustment only made by New Holland Area Service Managers, due to EPA emission regulations.
Contact New Holland representative for adjustment of fuel setting on high speed idle.



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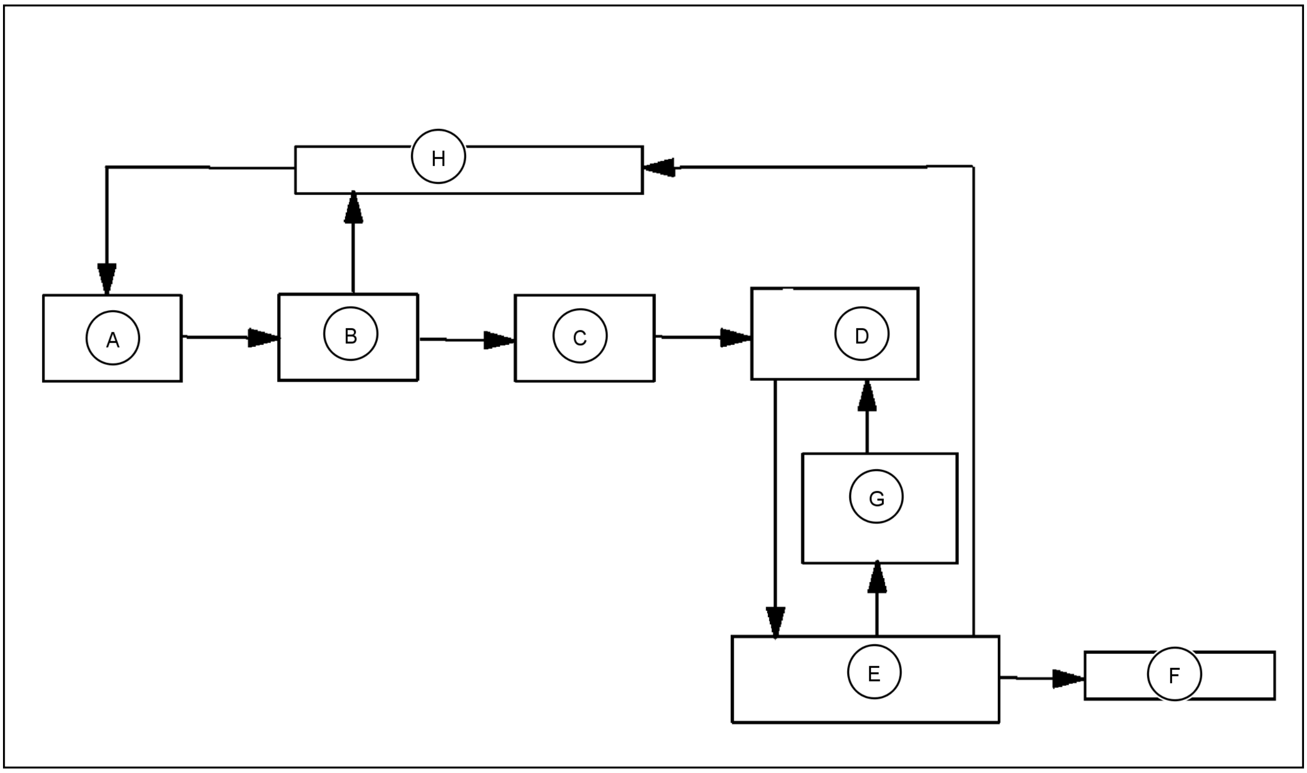
Next operation:
Fuel injection pump - Bleed Auto (B.20.A)

Fuel injection pump - Bleed Auto

Prior operation:
Fuel injection pump - Flow setting Fuel Screw/High Idle Adjustment (B.20.A)



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FUEL FLOW CHART

A -	Fuel tank	E -	Injectors (3 or 4 Cylinders)
B -	Fuel filter	F -	Cylinders
C -	Lift pump	G -	Return to injection pump
D -	Injection pump	H -	Return line to fuel tank

With a full tank of fuel, fuel from the tank will push air out of the fuel filter through the return to tank line. Fuel from the fuel filter will be delivered to the fuel transfer pump.

The Auto Bleed occurs whenever the engine is started and the throttle is set at full throttle.

1. Set the hand throttle at full throttle position.
2. Place ignition switch in the start position.
3. With the engine cranking, the fuel transfer pump, which is activated by the engine camshaft rotating, will deliver fuel to the injection pump.
4. Air that was in the injection pump will be returned to the fuel tank via the injector fuel return to tank line.

NOTE: *The injector fuel return to tank line is connected to the fuel filter return to tank line.*

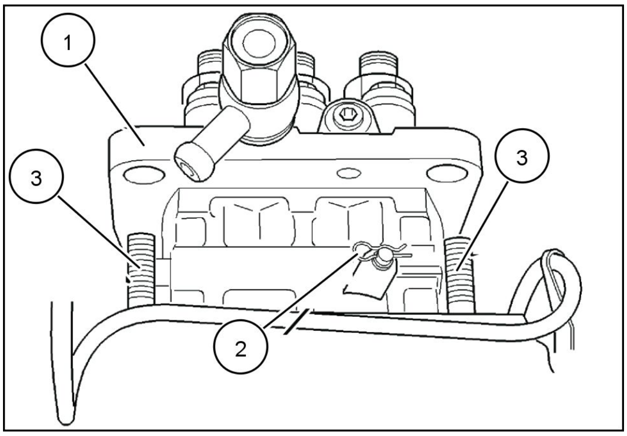
5. Rotate the engine until it starts.

NOTE: *Due to heat generation in the starter motor, do not engage the starter for more than 30 seconds continuously.*

Fuel injection pump - Install

Prior operation:
Crankshaft - Install Pulley (B.10.A).

1. Insert the injection pump, **(1)**, and shim in position in the block. Connect the injection pump control rack and governor link with the snap pin, **(2)**.
2. Push the injection pump, **(1)**, onto its mounting studs, **(3)**, and install the retaining nuts and bolts.



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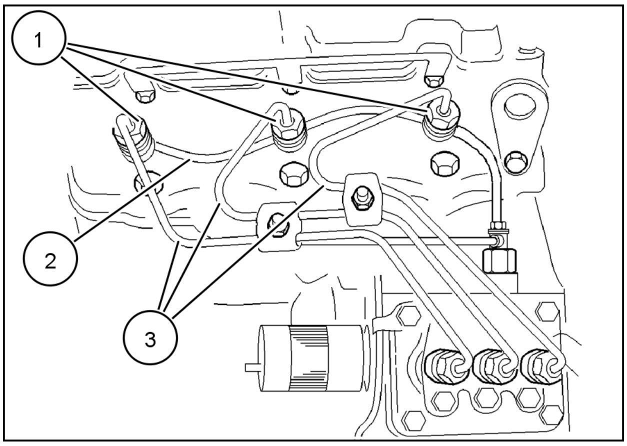
Next operation:
Hydraulic pump - Install Engine mounted (A.14.A).

Fuel injector - Remove

1. Clean all dirt, oil, and grease from the injectors, **(1)**, and surrounding areas.
2. Disconnect the fuel leak-off lines, **(2)**, and injector lines, **(3)**, from the injectors.



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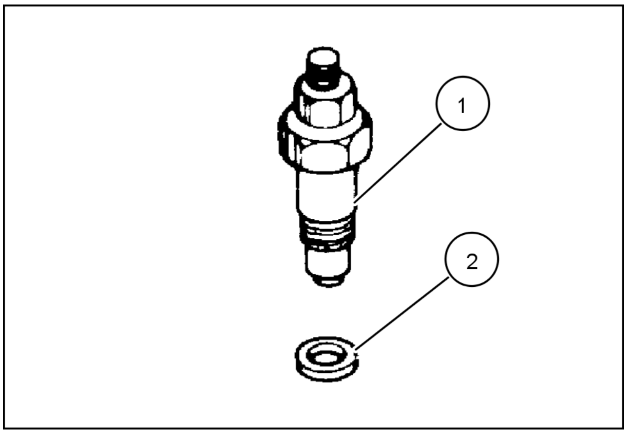
3. Remove the injectors, **(1)**, and sealing washers, **(2)**, from the cylinder head.



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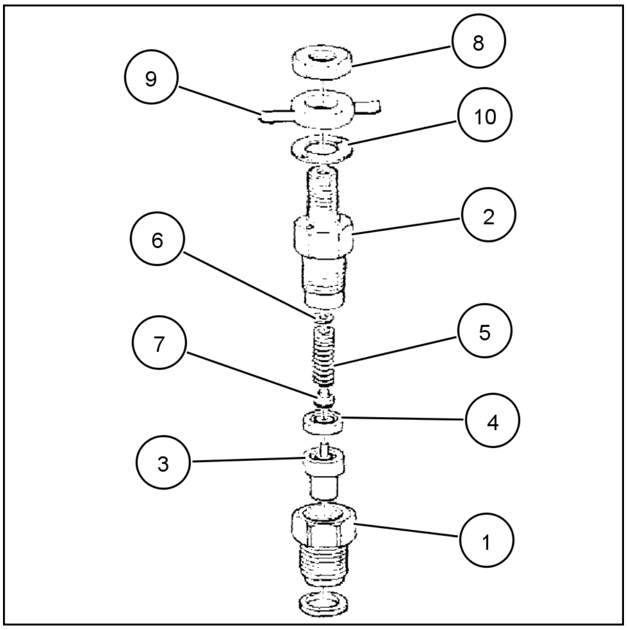
Next operation:
Fuel injector - Disassemble (B.20.A)

Fuel injector - Disassemble

Prior operation:
Fuel injector - Remove (B.20.A)

1. Loosen and remove the nozzle nut, **(1)**, from the injector body, **(2)**, being careful not to drop or damage the nozzle.
2. Remove the nozzle assembly, **(3)**, spacer, **(4)**, spring, **(5)**, and shim, **(6)**.
3. Clean the nozzle body and the needle valve. Check the nozzle for any burn or score marks. Check the needle seat for evidence of fuel leakage or carbon deposits.
4. Correct fuel leakage at the seat using a polishing stick and polish the seat area.
5. Inspect the upper and lower contact surfaces of the nozzle holder for a clean contact surface area.
6. Check the contact area between the push rod and spring seat.



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1. Nozzle Nut
2. Injector Body
3. Nozzle Assembly
4. Spacer
5. Spring
6. Shims
7. Rod
8. Nut
9. Leak-Off Line
10. Washer

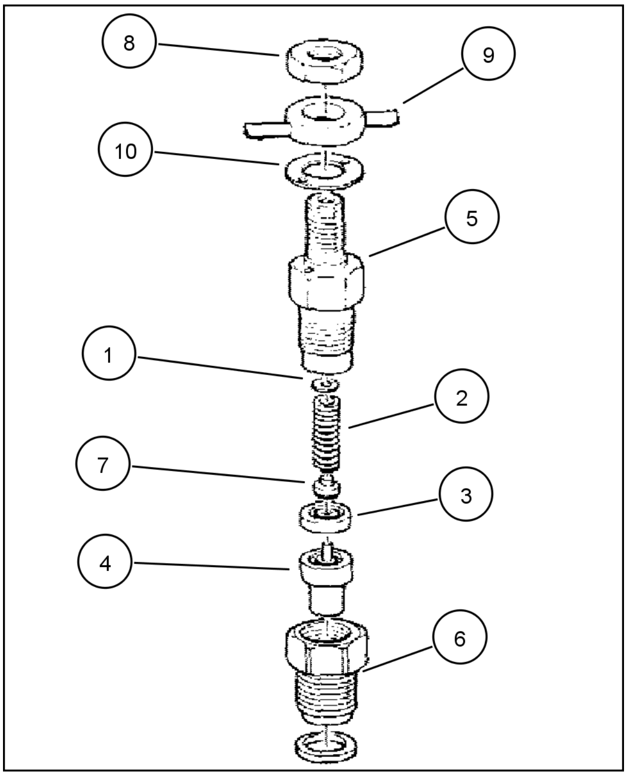
Next operation:
Fuel injector - Assemble (B.20.A)

Fuel injector - Assemble

Prior operation:
Fuel injector - Disassemble (B.20.A)

NOTE: *Clean all parts in clean fuel oil and assemble while still wet.*

1. Install the shim(s), **(1)**, spring, **(2)**, spacer, **(3)**, and nozzle assembly, **(4)**, in the injector body, **(5)**.
2. Install the nozzle nut, **(6)** and tighten to **39 - 44 N·m** (**28.8 - 32.5 lb ft**)
3. Check and adjust the injector pressure setting using injector tester **FNH01721** and adapter fitting No. 23622. Adjust the pressure setting to **14824 kPa** (**2150 psi**).



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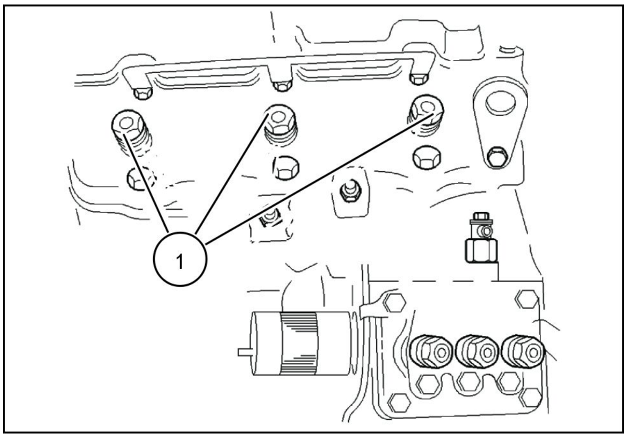
1. Shims
2. Spring
3. Spacer
4. Nozzle Assembly
5. Injector Body
6. Nozzle Nut
7. Rod
8. Nut
9. Leak-off Line
10. Washer

Next operation:
Fuel injector - Install (B.20.A)

Fuel injector - Install

Prior operation:
Fuel injector - Assemble (B.20.A)

1. Install the fuel injectors, **(1)** and torque to **60 - 69 N·m** (**43.4 - 50 lb ft**).



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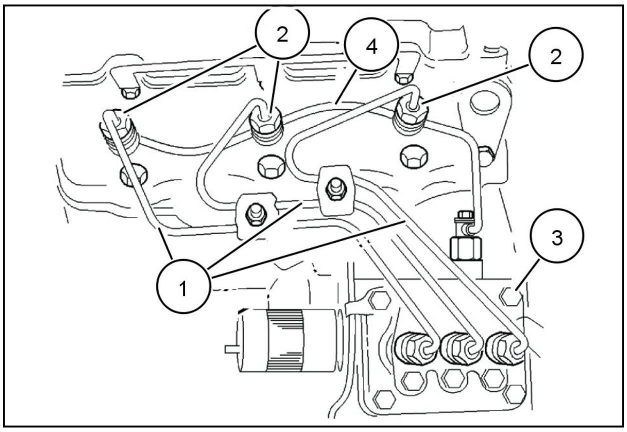
Fuel Injector Piping

2. Install the fuel return line, **(4)**, on the injectors, **(2)**, and injection pump, **(3)**.
3. Install the injection piping, **(1)**, and torque to **15 - 24 N·m** (**11 - 18 lb ft**).



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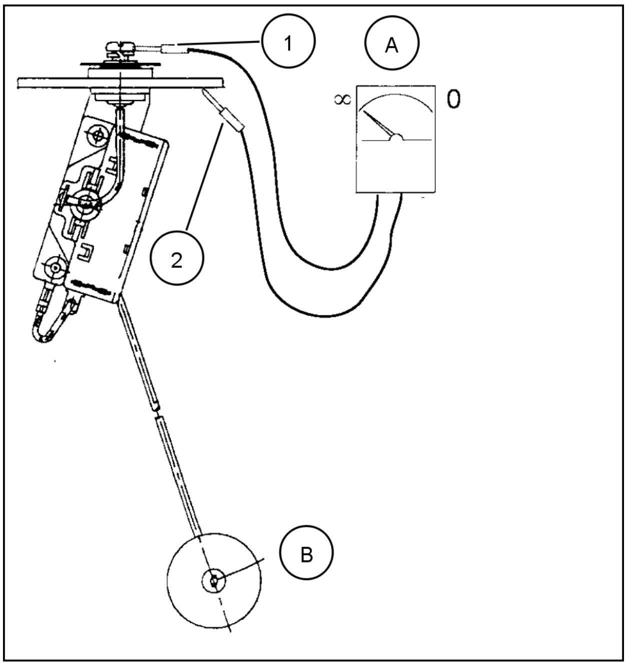
Sensing system - Test Fuel level sender

NOTE: *Use an ohmmeter ’A’ to test the fuel level sender.*

1. Remove the sender from the fuel tank.
2. Attach one of the meter leads to the center post, **(1)**, of the sender. Attach the other meter lead to the ground spade terminal, **(2)**, of the sender body.
   - With the sender in the EMPTY ’B’ (DOWN) position, the meter reading will be **162 Ω ± 10 Ω**.
   - With the sender in the FULL ’C’ (UP) position, the meter reading will be **10 Ω ± 4 Ω**.

NOTE: *If test results do not match the above, replace the fuel level sender.*



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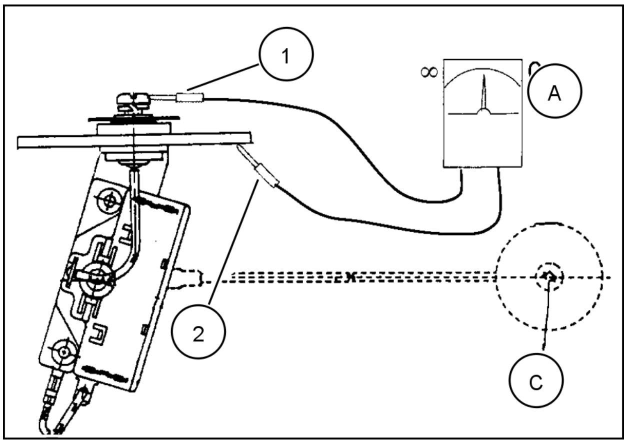
A - OHMMETER
B - EMPTY



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A - OHMMETER
C - FULL

FUEL AND INJECTION SYSTEM - Troubleshooting

Problem	Possible Cause	Correction
Fuel not reaching injection point	Fuel shutoff valve closed	Open the fuel shutoff valve
	Restricted fuel filter	Check and flush the fuel filter clean
	Faulty fuel stop solenoid	Check fuel stop solenoid. See "Fuel Stop Solenoid"
	Air in fuel system	Check for air leaks on the suction side of system. Bleed the fuel system
	Fuel leakage	Check the condition of the fuel lines and connections for tightness or possible damage
Fuel reaching nozzles but engine will not start	Low cranking speed	Check cranking
	Incorrect throttle adjustment	Check throttle control or travel
	Incorrect pump	Check pump timing
	Fuel Leakage	Check all fuel lines for leakage or possible damage
	Faulty injectors	See: **Fuel injector - Troubleshooting (B.20.A)**.
	Low compression	Check for air leaks on the suction side of system. Bleed the fuel system
Engine hard to start	Low cranking speed	Check cranking
	Incorrect throttle adjustment	Check throttle control or travel
	Restricted fuel filter	Check and flush fuel filter clean
	Contaminated fuel	Check for water in fuel
	Low compression	Check engine compression. See: **Cylinder head - Compression test (B.10.A)**.
	Air in fuel	Check for air leaks on the suction side of system. Bleed the fuel system
Engine starts and stops	Low cranking speed	Check cranking
	Contaminated fuel	Check for water in fuel
	Restricted air intake	Check for restrictions in the air intake
	Air in fuel system	Check for air leaks on the suction side of system. Bleed the fuel system
	Engine overheating	Check cooling system
Erratic engine operation (surge, misfiring, poor governor regulation)	Fuel leakage	Check all fuel lines for leakage or possible damage
	Fuel starvation	Check and flush clean restricted fuel lines
	Air in fuel system	Check for air leaks on the suction side of system. Bleed the fuel system
	Contaminated fuel	Check for water in fuel
	Faulty or sticking injector nozzles	See: **Fuel injector - Troubleshooting (B.20.A)**.
	Incorrect engine timing	Check for improper valve adjustment or faulty valve
	Sticky nose cone	Check nose cone for proper operation. Lubricate or replace if nose cone is binding on end of camshaft.
Engine does not develop full power or speed	Incorrect throttle adjustment	Check for insufficient throttle movement
	Incorrect Maximum no-load speed	Check maximum no-load speed adjustment
	Fuel starvation	Check and flush clean restricted fuel lines and filter
	Air in fuel system	Check for air leaks on the suction side of system. Bleed the fuel system
	Low compression	Check for air leaks on the suction side of system. Bleed the fuel system

Problem	Possible Cause	Correction
	Incorrect engine timing	Check for improper valve adjustment or faulty valve
Engine emits black smoke	Restricted air intake	Check for restrictions in the air intake
	Engine overheating	Check cooling system
	Faulty injectors	See: **Fuel injector - Troubleshooting (B.20.A)**.
	Low compression	Check for air leaks on the suction side of system. Bleed the fuel system
	Incorrect engine timing	Check for improper valve adjustment or faulty valve.
Pump fails to deliver fuel to all injectors	Blocked fuel lines to pump	Remove fuel lines and flush or replace
	Air in system	Check for air leaks on the suction side of system. Bleed the fuel system
	Control rod seized in "OFF" position	Repair or replace control rod
Pump fails to deliver fuel to one injector	Air in fuel line to injector	Bleed fuel line
	Plunger spring broken	Replace spring
	Plunger seized	Repair or replace barrel and plunger assembly
	Delivery valve seized	Repair or replace delivery valve
	Badly scored plunger and barrel	Replace plunger and barrel assembly
Governor fails to maintain maximum or minimum no-load fuel delivery	Control spring broken	Replace control spring
	Governor weights seized	Repair or replace weight assembly and/or camshaft
	Governor weight carrier broken	Replace weight assembly
	Nose cone seized	Replace nose cone and/or camshaft
	Pump link spring broken	Replace spring

Throttle command - Troubleshooting (Governor)

Problem	Possible Cause	Correction
Sluggish governor response	Nose cone binding on camshaft.	Replace or lubricate nose cone on end of camshaft.
	Fuel rack binding in injection pump.	Lubricate rack with penetrating oil or submerse rack mechanism in automatic transmission fluid. Repair or replace injection pump.
	Governor weights binding on pivot pins.	Repair governor assembly
	Linkage arm between governor linkage and injection pump rubbing on cylinder block.	Straighten or replace linkage arm assembly.
	Binding of throttle arm pivot shaft.	Lubricate or replace throttle arm shaft.
Engine runs away (excessive speed)	Nose cone stuck at "in" position.	Replace nose cone or check camshaft for binding.
	Linkage arm between governor linkage and injection pump stuck.	Repair or replace linkage arm assembly.
	Fuel rack stuck in full fuel position	Lubricate or repair injection pump.
Engine will not develop rated speed	Fuel screw adjusted too far into engine block.	Contact New Holland representative for adjustment.
	Fuel rack stuck in low fuel position.	Lubricate or repair injection pump.
Engine speed surging	Broken dampener spring on linkage arm.	Replace dampener spring.
	Damaged governor spring.	Replace governor spring.
	Worn linkage.	Inspect and repair linkage as needed.

Fuel injector - Troubleshooting

Problem	Possible Cause	Correction
Nozzle does not "buzz" while injecting	Needle valve stuck	Check needle valve for carbon build-up and binding
	Excessive fuel leakage	Check valve and valve seat for scores or other indications of leakage
	Nozzle damage	Inspect faces and tighten nozzle retaining nut.
Nozzle leakage	Needle valve worn	Replace nozzle assembly
	Blocked nozzle assembly	Check for carbon or foreign matter on faces of nozzle and nozzle holder. Flush, clean, or replace.
	Loose nozzle retaining nut	Inspect faces and tighten nozzle retaining nut.
Nozzle opening pressure incorrect	Incorrectly adjusted nozzle retaining nut	Check retaining nut for looseness
	Damaged nozzle or seized needle valve	Replace nozzle assembly
	Blocked nozzle orifice	Check orifice for carbon or foreign matter. Flush clean or replace.
Nozzle seat leakage	Nozzle incorrectly seated	Check for carbon or foreign matter on faces of nozzle and nozzle holder. Flush, clean, or replace.
	Sticking or binding needle valve.	Repair or replace nozzle assembly.

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AIR INTAKE SYSTEM - 30.A

Workmaster 45
Workmaster 55

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AIR INTAKE SYSTEM - 30.A

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Air intake manifold

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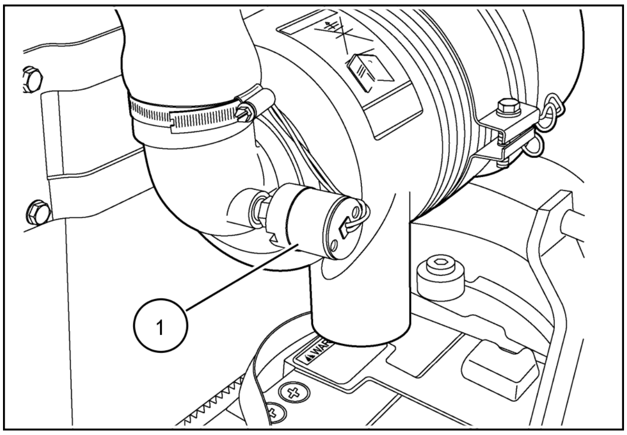
Sensing system - Dynamic description - Air filter restriction switch

The air filter restriction switch, **(1)**, is located on the air filter exit tube. This switch is a vacuum operated switch, which detect when the air filter becomes restricted. The contacts within the switch are normally open. When air filter becomes restricted with dirt, the vacuum created closes the contacts in the switch, supplying current for the indicator light in the instrument panel. The switch is set to close at **6.2 kPa** (**635 mm** (**25 in**) of water) of vacuum.



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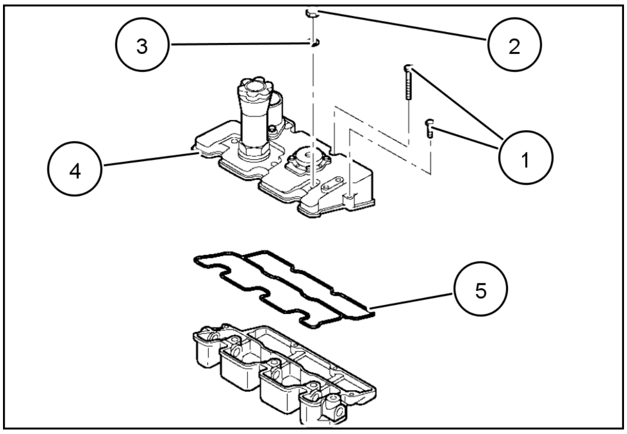
Air intake manifold - Remove

Prior operation:
Fan, Water Pump, and External Oil Tube - Removal; See: **ENGINE - Disassemble (B.10.A)**.

NOTE: *The prior and next operation procedures refer to Engine Overhaul.*

1. Remove the retaining bolts, **(1)**, cap nuts, **(2)**, and seal washers, **(3)**.
2. Remove the air inlet manifold, **(4)**, and gasket, **(5)**.



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Next operation:
Rocker Arm Shaft and Support Bracket - Remove; See: **ENGINE - Disassemble (B.10.A)**.

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ENGINE AND PTO IN - B

AIR INTAKE SYSTEM - 30.A

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ENGINE AND PTO IN - B

EXHAUST SYSTEM - 40.A

Workmaster 45
Workmaster 55

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ENGINE AND PTO IN - B

EXHAUST SYSTEM - 40.A

SERVICE

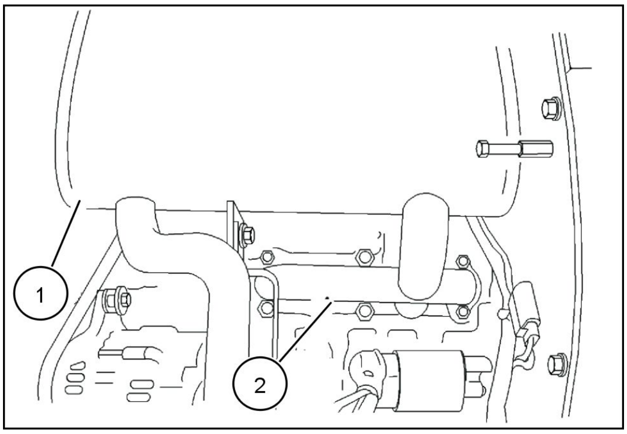
Exhaust manifold

Install 3

Exhaust manifold - Install

Prior operation:
Alternator - Install (A.30.A).

1. Install the exhaust manifold **(2)**, gasket and muffler **(1)**.



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NOTE: *The prior operation procedure refers to Engine Overhaul.*

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ENGINE COOLANT SYSTEM - 50.A

Workmaster 45
Workmaster 55

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ENGINE COOLANT SYSTEM - General specification

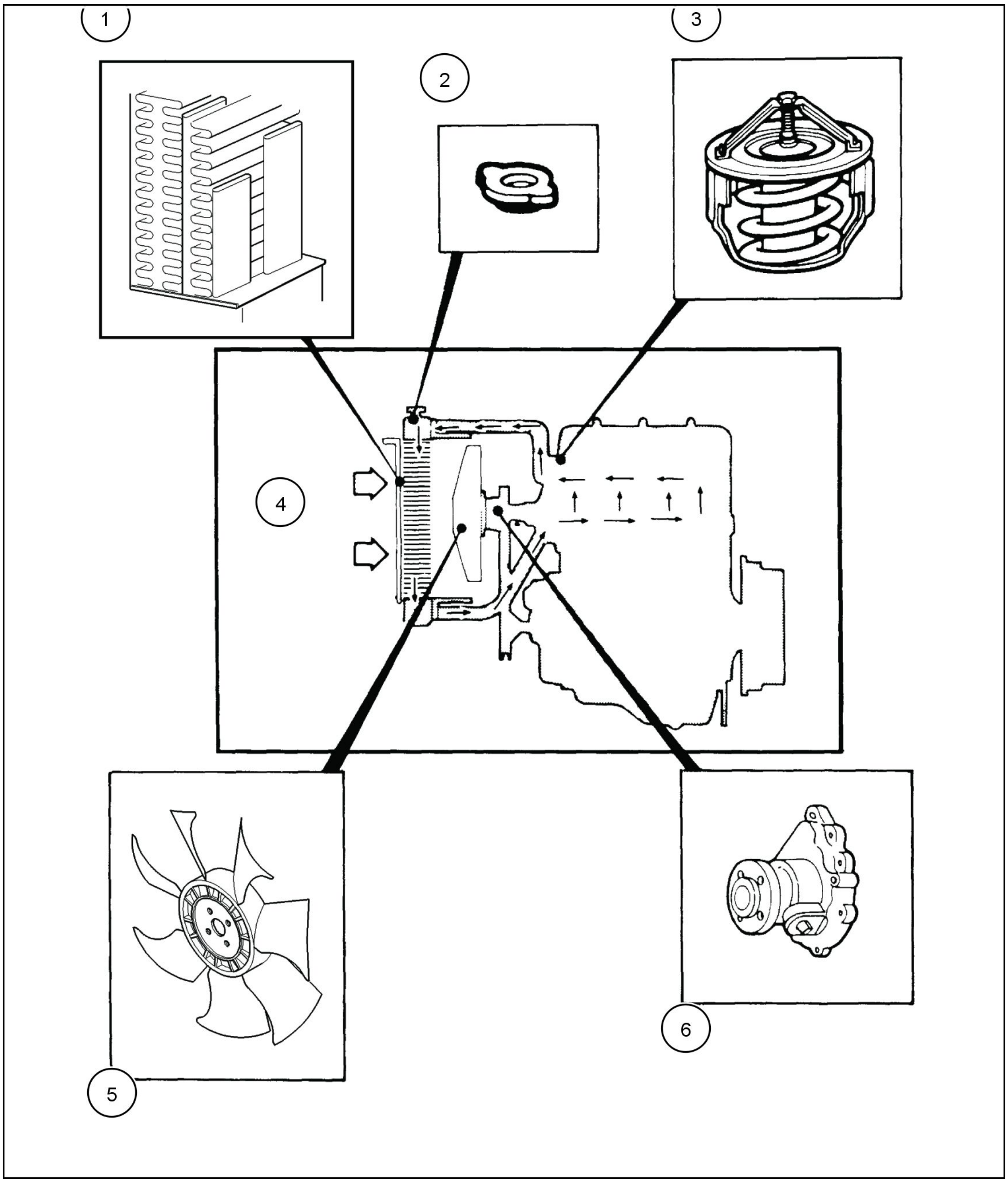
	WORKMASTER 45	WORKMASTER 55
Engine Model	ISM N844L	ISM N844LT
Type of System	Pressurized liquid w/recirculating by-pass	
Water Pump	Centrifugal	
Drive Belt Deflection (Tension)	**10 - 15 mm** (**0.39 - 0.59 in**) when **89 - 111 N** (**20 - 25 lb**) force is applied midway between pulleys.	
Thermostat		
Starts to Open	**80 - 84 °C** (**176 - 183 °F**)	
Fully Open	**95 °C** (**203 °F**)	
Radiator Cap Pressure Rating	**90 kPa** (**13 psi**)	
Coolant	Ethylene glycol and water in a 50/50 mixture.	
Capacity	**7.9 l** (**8.3 US qt**)	**8.0 l** (**8.4 US qt**)

ENGINE COOLANT SYSTEM - Dynamic description

The cooling system is the recirculating bypass type with a full length water jacket for each cylinder cast into the block. The coolant is drawn from the bottom of the radiator by the water pump and passes around the cylinders and into the cylinder head.

The thermostat is located in the front of the cylinder head and thermostatically controls the flow of coolant from the engine to the radiator. When the thermostat is closed only a small amount of coolant is permitted to flow through the thermostat bypass to the radiator to effect a faster warm-up. When the thermostat is open, the coolant flows from the water outlet connection to the top tank of the radiator for maximum cooling.

Cooling occurs as the coolant passes down through the radiator cores which are exposed to the air flow created by the fan as air is drawn through the radiator.



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(1) Radiator	**(4)** Air Flow
(2) Radiator Cap	**(5)** Fan
(3) Thermostat	**(6)**Water Pump

Maintenance: **ENGINE COOLANT SYSTEM - Service instruction (B.50.A)**.

Radiator - Dynamic description - Radiator cap (B.50.A).

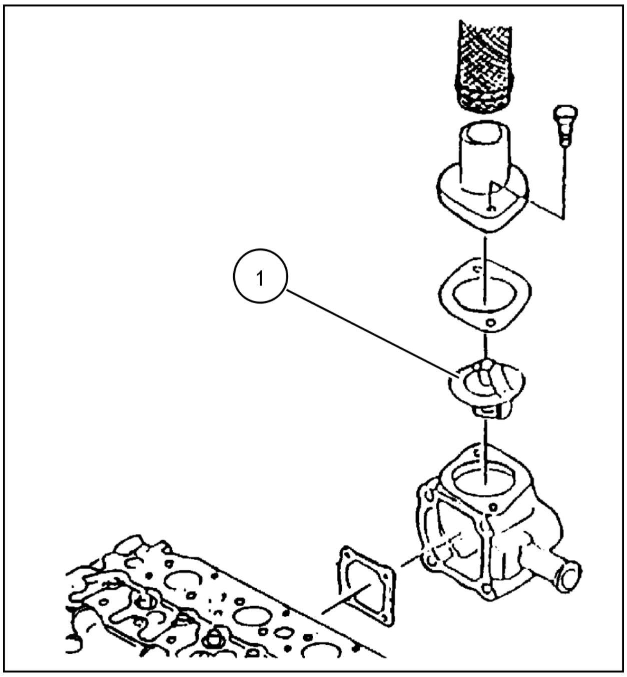
Thermostat - Dynamic description (B.50.A).

Water pump - Dynamic description (B.50.A).

Fan and drive - Dynamic description (B.50.A).

Thermostat - Dynamic description

The thermostat **(1)**, is located between the coolant outlet on the engine and the radiator. In this position the thermostat is able to sense the coolant temperature in the engine and regulate the flow of coolant to the radiator. When the engine is cold, only a small amount of coolant flows to the radiator through the thermostat bypass. As the engine warms up, the thermostat opens to allow sufficient coolant flow to the radiator to maintain a constant engine temperature.



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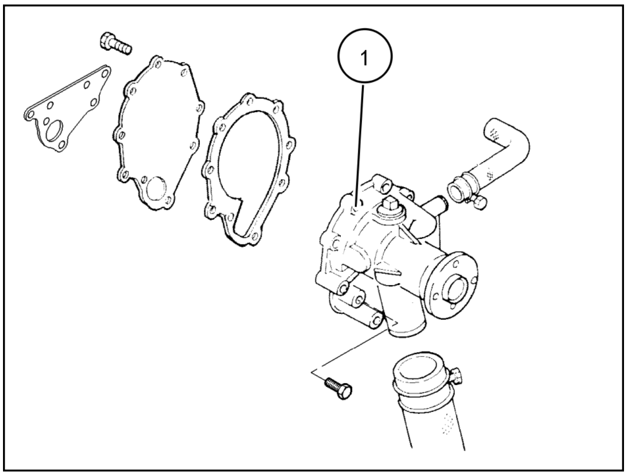
Water pump - Dynamic description

The water pump **(1)**, is an impeller attached to a shaft which is belt driven by the engine crankshaft. The impeller circulates water by centrifugal force. Coolant entering the pump housing from the radiator through the lower hose is thrown outward against the housing with sufficient force to cause a circulating action.



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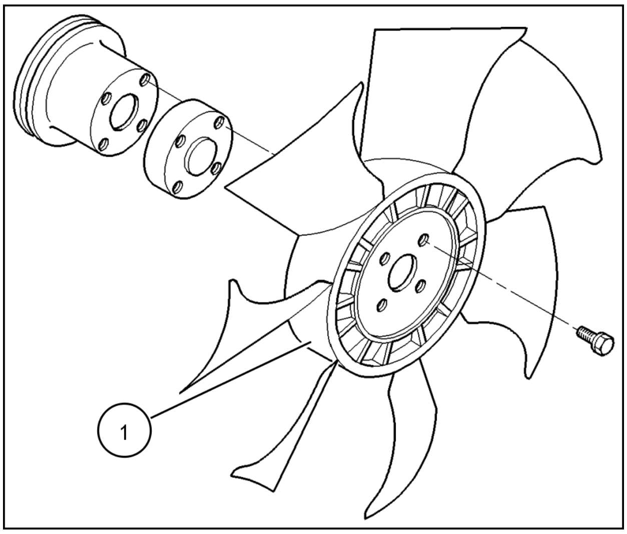
Radiator - Dynamic description - Radiator cap

The radiator cap acts to pressurize the cooling system, as a pressure relief valve and also acts as a vent valve. The pressure valve permits a limited pressure buildup in the cooling system as the coolant heats up. This increased pressure increases the boiling point of the coolant. If excess pressure builds up in the system, the pressure relief valve will open until the pressure returns to the proper level **90 kPa** (**13 psi**).

When the engine is shut off and the coolant cools, a vacuum condition is created in the system. A vent valve in the radiator cap opens to permit outside air pressure to enter the system when this condition exists.

Fan and drive - Dynamic description

A seven-blade cooling fan **(1)**, is belt driven by the engine crankshaft and is mounted on the water pump shaft. The cooling fan is positioned behind the radiator to draw air over the radiator cooling fins. To increase and concentrate the volume of air flowing through the radiator, a shroud is positioned around the fan.



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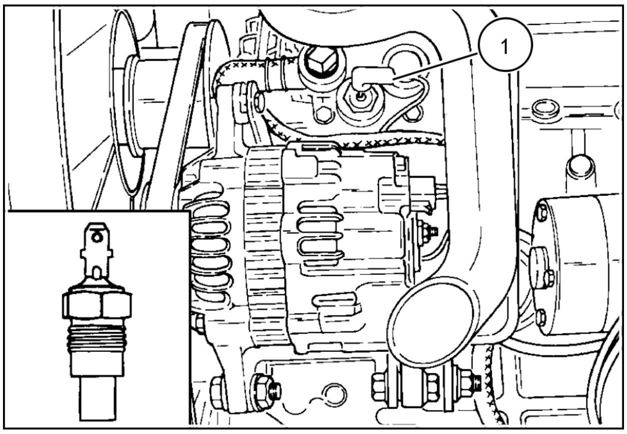
Sensing system - Static description Engine coolant temperature sending unit

The coolant temperature sender, **(1)**, is located at the left front side of the engine inside the thermostat housing. This sender regulates a variable resistance to ground, which translates into the movement of the temperature gauge.



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ENGINE COOLANT SYSTEM - Service instruction

⚠ WARNING ⚠

The cooling system operates under pressure controlled by the recovery tank and radiator caps. Never remove the caps while the engine is running or the coolant is hot. Let the system cool. Turn the radiator cap to the first stop and allow any pressure to escape. Then remove the cap. Unscrew the recovery tank cap slowly to allow any pressure to escape. Failure to comply could result in death or serious injury.

M1591

1. Clean the cooling system to remove rust, sludge, and other foreign material by using a coolant system cleaning solvent. In severe cases, pressure flushing may be required. A pulsating or reverse flow flushing will more effectively loosen and remove foreign material than a steady flushing in normal direction of coolant flow. If pressure flushing is to be used, always remove the thermostat and make sure the head bolts are tightened properly.
2. Coolant
    - The coolant is a permanent type ethylene-glycol base antifreeze and should be used all year.
    - Drain and flush the cooling system every twelve months and replace the coolant with fresh antifreeze and pure water.
    - After the coolant has been drained from the radiator and block, flush the system by placing a water hose in the radiator filler neck. With the drain open and the system full of water, start the engine and run it until the water flowing from the drain is clear. Stop the engine and allow the system to drain, then replace the coolant with new 50/50 mixture antifreeze and pure water.

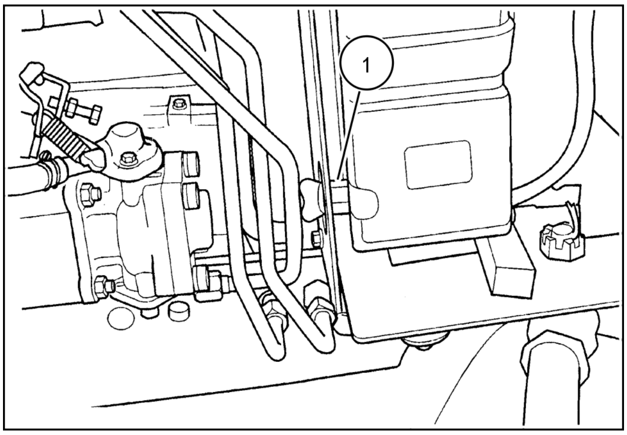
ENGINE COOLANT SYSTEM - Overhaul

1. **Radiator - Remove (B.50.A)**.
2. Radiator Inspection and Repair
    1. Inspect the radiator fins and be sure they are free from obstruction.
    2. Check the radiator for signs of coolant leakage and repair as required.
3. **Radiator - Install (B.50.A)**.
4. **Water pump - Remove (B.50.A)**.
5. **Water pump - Inspect (B.50.A)**.
6. **Water pump - Install with cooling fan (B.50.A)**.
7. **Thermostat - Remove (B.50.A)**.
8. **Thermostat - Test (B.50.A)**.
9. **Thermostat - Install (B.50.A)**.

Thermostat - Remove

Prior operation:
Water pump - Install with cooling fan (B.50.A).

1. Remove the radiator cap.
2. Open the radiator drain tap, **(1)**, and collect the coolant in a clean container.



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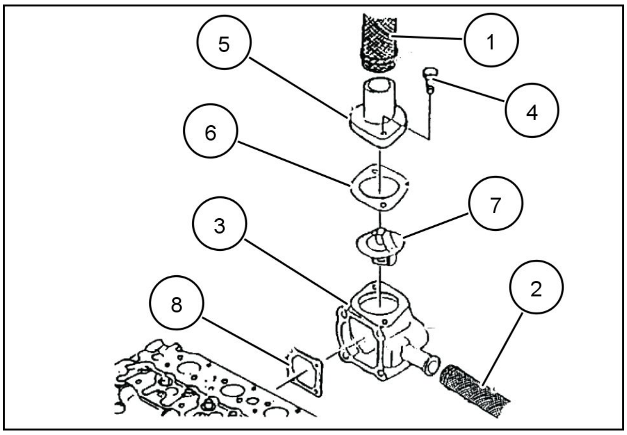
3. Remove the radiator hose, **(1)**, and bypass hose, **(2)**, from the thermostat housing, **(3)**.
4. Remove the retaining bolts, **(4)**, and remove the thermostat cover, **(5)**, gasket, **(6)**, thermostat, **(7)**, and gasket, **(8)**.



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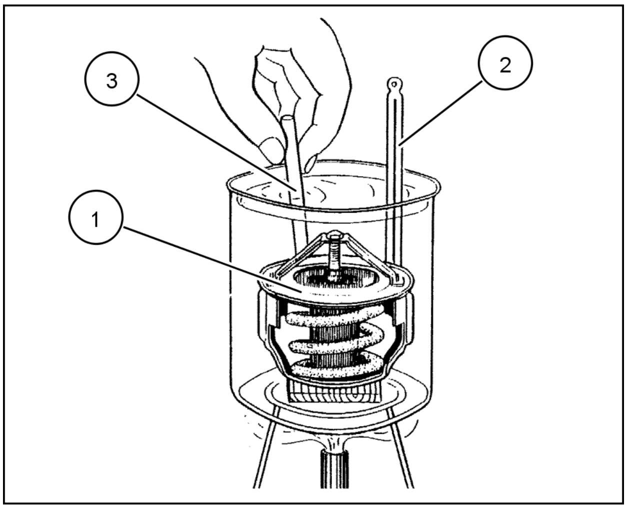
Next operation:
Thermostat - Test (B.50.A).

Thermostat - Test

Prior operation:
Thermostat - Remove (B.50.A).

1. Place the thermostat **(1)**, in a container filled with a 50/50 mixture of antifreeze and water. Insulate the thermostat from the bottom of the container.
2. Place a high temperature thermometer **(2)**, in the coolant mixture and heat the container.
3. Use a **0.08 mm** (**0.003 in**) feeler gauge **(3)**, to determine when the thermostat begins to open.
4. Note the coolant temperature at which the thermostat starts to open and when it is fully opened.
5. Replace the thermostat if it fails to open at the specified temperature.

   Thermostat opening temperature:
   Start to open: **80 - 84 °C** (**176 - 183 °F**)- All models
   Fully open: **95 °C** (**203 °F**).
6. Thoroughly clean the gasket mating surfaces before installing thermostat.



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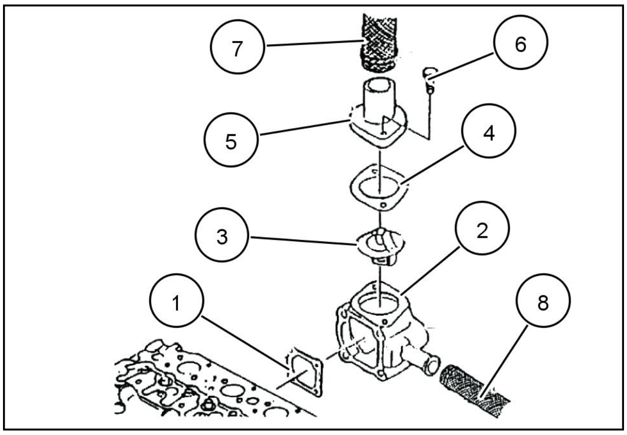
Next operation:
Thermostat - Install (B.50.A).

Thermostat - Install

Prior operation:
Thermostat - Test (B.50.A).

1. Attach gasket, **(1)**, and thermostat housing, **(2)**, to the engine block.
2. Place the thermostat, **(3)**, in position in the thermostat housing, **(2)**.
3. Install the gasket, **(4)**, and thermostat cover, **(5)**, and tighten the retaining bolts, **(6)**.
4. Install the radiator hose, **(7)**, and bypass hose, **(8)**, on the thermostat housing **(2)**, and tighten the hose clamps.
5. Close the radiator drain and refill the radiator with 50/50 mixture of antifreeze and pure water.
6. Install the radiator cap and start the engine and run for a few minutes to check for any leakage.



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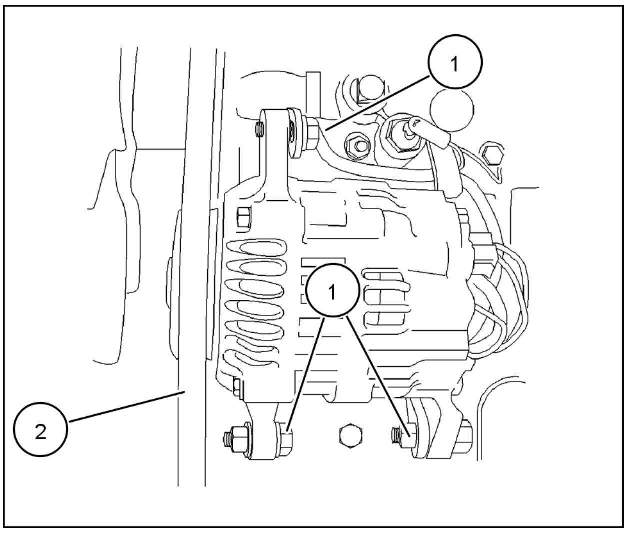
Water pump - Remove

1. Remove radiator assembly. See: **Radiator - Remove (B.50.A)**.
2. Loosen the alternator mounting bolts, **(1)**, and adjusting bracket and remove the drive belt, **(2)**.



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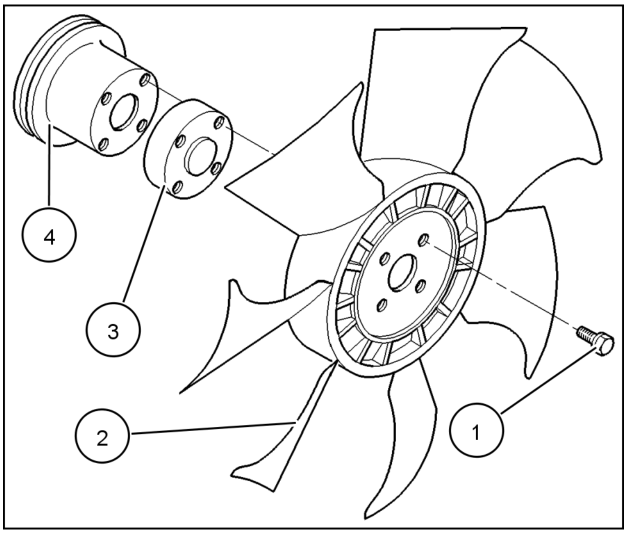
3. Remove the attaching bolts, **(1)**, cooling fan, **(2)**, fan holder, **(3)**, and pulley, **(4)**.



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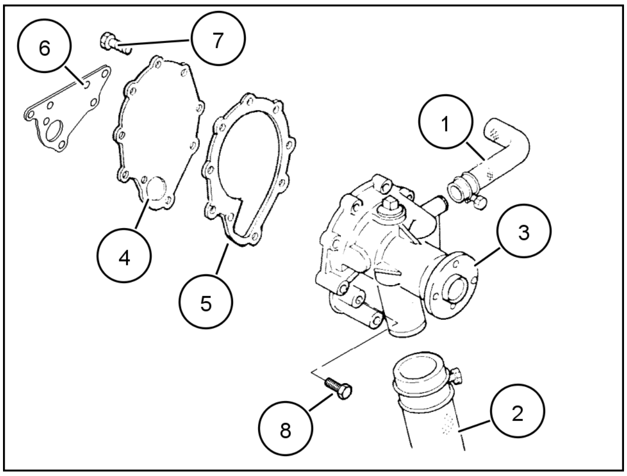
4. Remove the bypass hose, **(1)**, and lower radiator hose, **(2)**, from the water pump, **(3)**.
5. Remove the water pump retaining bolts, **(8)**, and remove the water pump, **(3)**, and gasket, **(5)**, from engine.
6. Remove the water pump mounting plate, **(4)**, and gasket, **(6)**.



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(1) Bypass Hose
(2) Lower Radiator Hose
(3) Water Pump
(4) Mounting Plate
(5) Gasket
(6) Gasket
(7) Retaining Bolt
(8) Water Pump Retaining Bolt

Next operation:
Water pump - Inspect (B.50.A).

Water pump - Inspect

Prior operation:
Water pump - Remove (B.50.A).

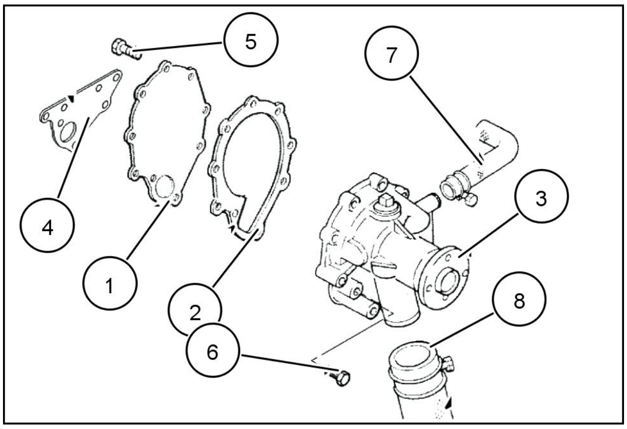
1. Inspect the water pump for indications of coolant leakage from around the pump shaft. If coolant leakage is evident, or if the water pump is noisy when running, replace the water pump.

Next operation:
Water pump - Install with cooling fan (B.50.A).

Water pump - Install with cooling fan

Prior operation:
Valve cover - Install (B.10.A).
Prior operation:
Water pump - Inspect (B.50.A).

1. Install the water pump mounting plate, **(1)**, and new gasket, **(2)**.
2. Install the water pump, **(3)**, and new gasket, **(4)**, and tighten the retaining bolts, **(5)** and **(6)**.
3. Install the bypass hose, **(7)**, and lower radiator hose, **(8)**, on the water pump and tighten the hose clamps.



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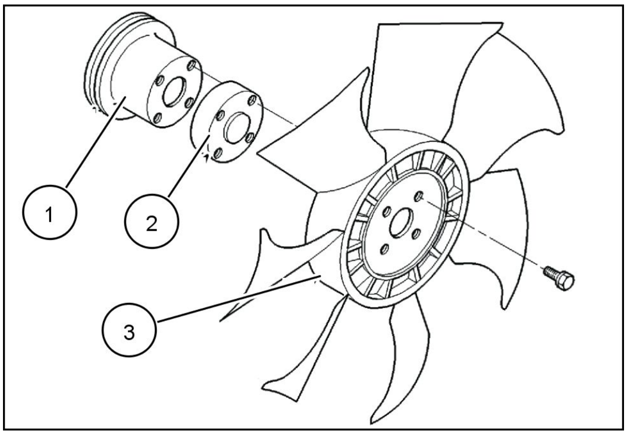
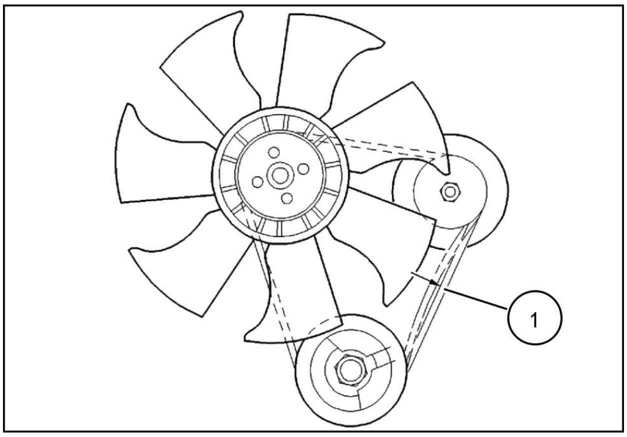
4. Install the pulley **(1)**, fan holder, **(2)**, and cooling fan, **(3)**, and tighten the attaching bolts.



SECT10C01PG95_2 2

5. Install the drive pulley and adjust the alternator drive belt tension to obtain a deflection, **(1)**, of **10 - 15 mm** (**0.39 - 0.59 in**) when **89 - 111 N** (**20 - 25 lb**) is applied between the pulleys and tighten the alternator mounting bolts.
6. Install the radiator assembly. See **Radiator - Install (B.50.A)**.

NOTE: *The next operation procedure refers to engine overhaul.*

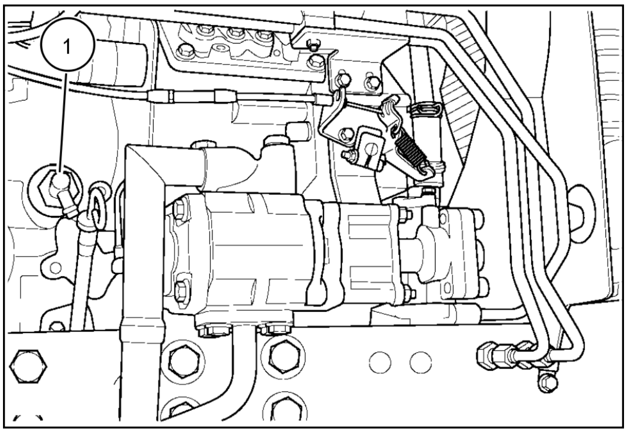


SECT10C01PG95_3 3

Next operation:
Cold start aid - Install Glow plug and connector (B.80.A).

Radiator - Remove

1. Drain the radiator by removing the lower radiator hose, **(2)**, in Figure **2**, and engine block at petcock, **(1)**, in a clean container. Remove the radiator cap to assist draining.



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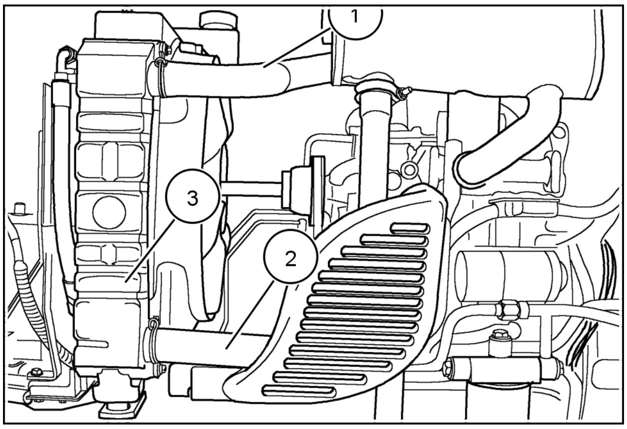
2. Remove the upper **(1)**, and lower **(2)**, radiator hoses from the radiator **(3)**.



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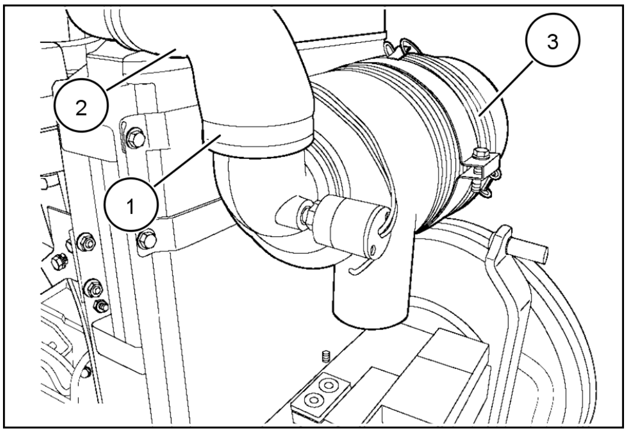
3. Loosen the clamp, **(1)**, on the air inlet hose, **(2)**. Remove the bolts securing the air cleaner, **(3)**, to the radiator.
4. Remove the air inlet tube, **(2)**, from the engine.



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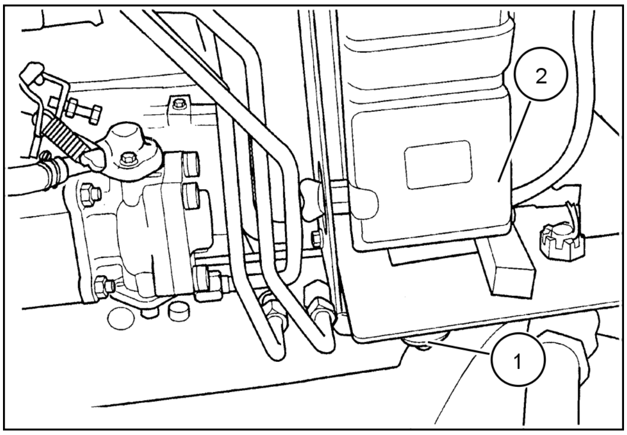
5. Loosen and remove the radiator mounting bolt **(1)**, from the radiator **(2)**. Repeat for the opposite side.
6. Loosen and remove the radiator support brace, and remove the radiator from the tractor.



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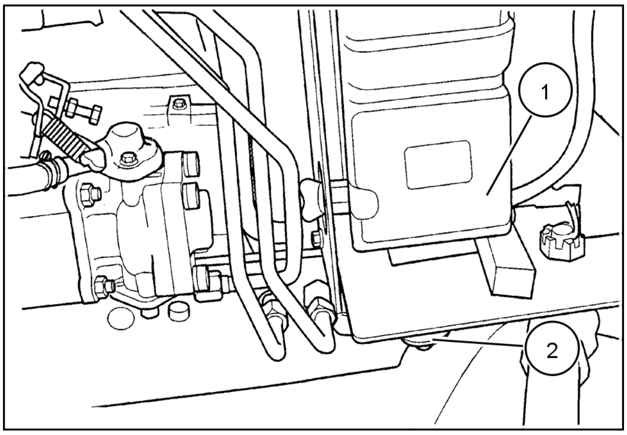
Next operation:
Radiator Inspect; See: **ENGINE COOLANT SYSTEM - Overhaul (B.50.A)**.

Radiator - Install

Prior operation:
Radiator Inspection and Repair; See: **ENGINE COOLANT SYSTEM - Overhaul (B.50.A)**.

1. Place the radiator assembly, **(1)**, in position on the tractor frame.
2. Install and tighten the radiator mounting bolts, **(2)**.
3. Install the radiator top support brace.



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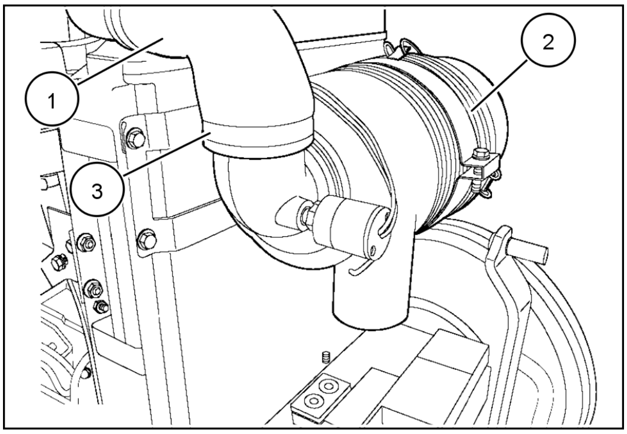
4. Install the air inlet tube, **(1)**, to the top of engine. Attach the air cleaner, **(2)**, to the air inlet tube and tighten clamp, **(3)**.
5. Using the bolts, secure the air cleaner, **(2)**, to the radiator.



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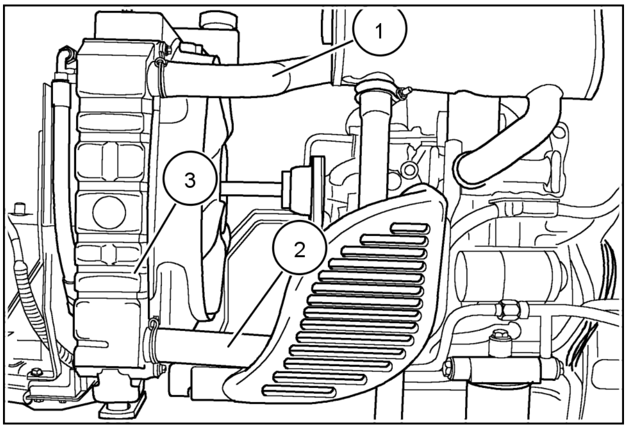
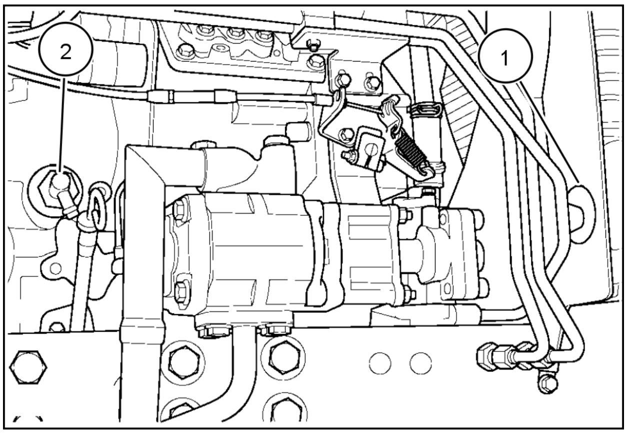
6. Install the upper, **(1)**, and the lower, **(2)**, radiator hoses on the radiator, **(3)**. Secure with the spring clamps.



30996394 3

7. Close the radiator drain tap **(1)**, and engine block petcock **(2)**.
8. Replace the coolant with 50/50 mixture antifreeze and pure water.
9. Install the radiator cap. Start the engine and run for several minutes and check the hose connections for any leakage.



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Sensing system - Test Engine coolant temperature sending unit

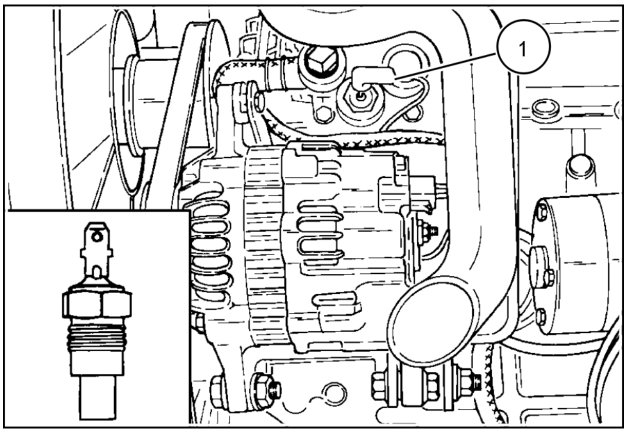
⚠ WARNING ⚠

To avoid contact with moving engine parts, always shut off the engine when testing the sending the unit. Failure to comply could result in death or serious injury.

M1648

NOTE: *Engine paint must be removed from sending unit body or the ohmmeter will indicate a false reading when the ohmmeter test lead is touched to sending unit body.*

1. Disconnect the main wiring harness terminal, **(1)**, from the coolant temperature sending unit.



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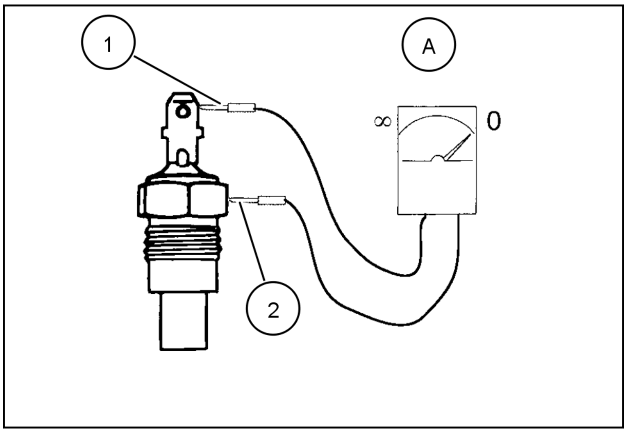
2. Using an ohmmeter, touch one test lead to the sending unit terminal, **(1)**. Touch the other test lead to the sending unit body, **(2)**.



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A - OHMMETER

3. Observe the ohmmeter for resistance readings at different engine operating temperatures. If resistance is too high, the sending unit us defective and needs replaced.

Coolant Temperature	Sending Unit Temperature
35 °C (95 °F)	**670 Ω ± 80 Ω**
80 °C (176 °F)	**118 Ω ± 6 Ω**
105 °C (221 °F)	**54.5 Ω ± 2.7 Ω**
115 °C (239 °F)	**42 Ω ± 2.5 Ω**

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ENGINE AND PTO IN - B

LUBRICATION SYSTEM - 60.A

Workmaster 45
Workmaster 55

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LUBRICATION SYSTEM - General specification Engine

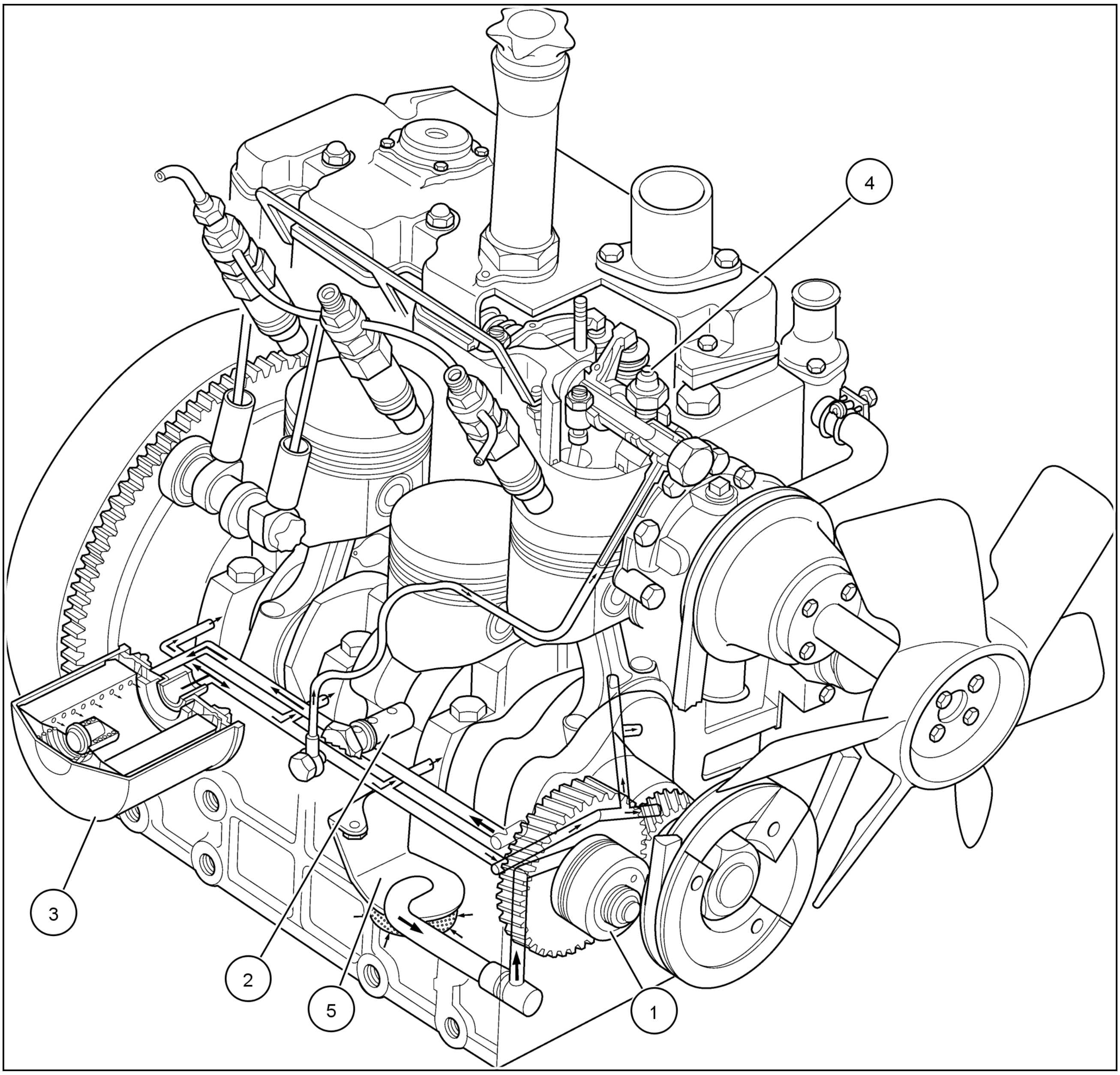
	WORKMASTER 45	WORKMASTER 55
Engine Model	ISM N844L	ISM N844LT
Pressure Relief Valve		
Opening Pressure	**294.1 - 342.7 kPa** (**42.66 - 49.7 psi**)	**294.1 - 342.7 kPa** (**42.66 - 49.7 psi**)
Fully Open at **3000 RPM**	**490.2 kPa** (**71.1 psi**)	**490.2 kPa** (**71.1 psi**)
Rotor-to-Vane Clearance		
Standard	**0.1 - 0.15 mm** (**.004 - 0.006 in**)	**0.1 - 0.15 mm** (**0.004 - 0.006 in**)
Maximum	**0.25 mm** (**0.010 in**)	**0.25 mm** (**0.010 in**)
Rotor-to-Cover Clearance		
Standard	**0.1 - 0.15 mm** (**0.004 - 0.006 in**)	**0.1 - 0.15 mm** (**0.004 - 0.006 in**)
Maximum	**0.20 mm** (**0.008 in**)	**0.20 mm** (**0.008 in**)
Oil Pump Volume	**4.5 l** (**1.18 US gal**)	**4.5 l** (**1.18 US gal**)

LUBRICATION SYSTEM - Dynamic description

Description of Operation - Engine Lubrication System

The oil pump assembly is located within the idler gear at the front of the block, below and to the left of the crankshaft as viewed from the front of the engine. The oil pump is driven by the crankshaft gear.

Oil is picked up from the sump through the suction strainer and intake tube and drawn into the lower side drilling in the block to the oil pump. Oil from the pump flows through passages in the block, past the relief valve, through the oil filter and returns to the main oil gallery in the area of the drilled bolt located on the side of the block. Oil flow in the main oil gallery extends to the four main bearings. Oil flow to the main bearings passes through drilled passages in the crankshaft to the three connecting rod bearings. The remaining portion of the oil flow is directed through the external tube to the rocker arm assembly. Oil flows from the external tube into a passage in the rocker arm bracket to the rocker arm shaft. Oil leakage from clearance between the rocker arms and the shaft overflows in the valve cover and lubricates the valve stems, push rods, and tappets. The relief valve is mounted on the side of the engine block and intersects the main oil passage. When the oil pressure exceeds the rated pressure, oil is bypassed through the relief valve directly to the sump. The cylinder walls, pistons, and piston pins are splash lubricated by the crankshaft.



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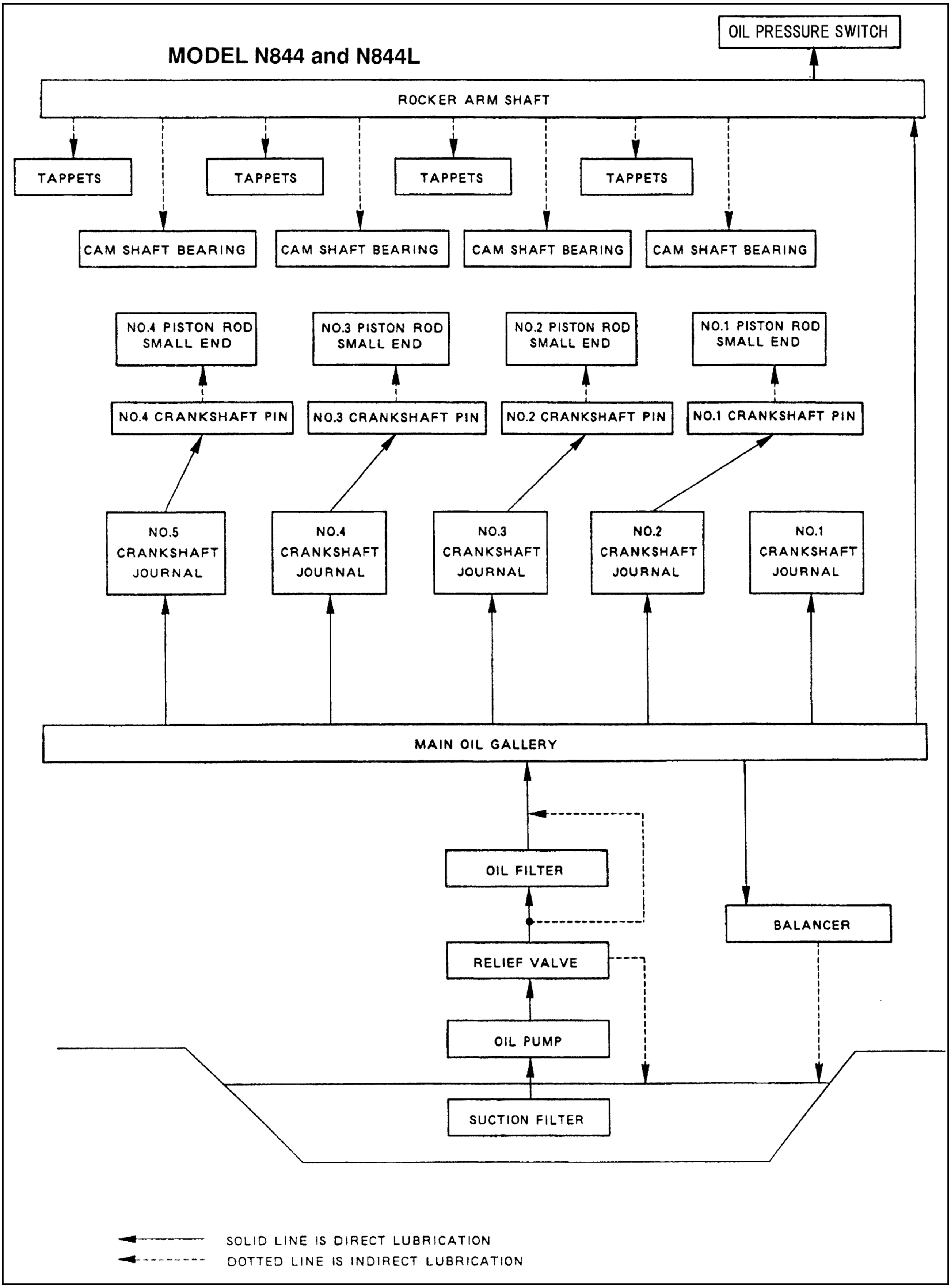
(1) Oil Pump

(2) Relief Valve

(3) Oil Filter

(4) Oil Pressure Switch

(5) Suction Strainer


MODEL N844 and N844L
OIL PRESSURE SWITCH
ROCKER ARM SHAFT
TAPPETS
TAPPETS
TAPPETS
TAPPETS
CAM SHAFT BEARING
CAM SHAFT BEARING
CAM SHAFT BEARING
CAM SHAFT BEARING
NO.4 PISTON ROD SMALL END
NO.3 PISTON ROD SMALL END
NO.2 PISTON ROD SMALL END
NO.1 PISTON ROD SMALL END
NO.4 CRANKSHAFT PIN
NO.3 CRANKSHAFT PIN
NO.2 CRANKSHAFT PIN
NO.1 CRANKSHAFT PIN
NO.5 CRANKSHAFT JOURNAL
NO.4 CRANKSHAFT JOURNAL
NO.3 CRANKSHAFT JOURNAL
NO.2 CRANKSHAFT JOURNAL
NO.1 CRANKSHAFT JOURNAL
MAIN OIL GALLERY
OIL FILTER
BALANCER
RELIEF VALVE
OIL PUMP
SUCTION FILTER
SOLID LINE IS DIRECT LUBRICATION
DOTTED LINE IS INDIRECT LUBRICATION

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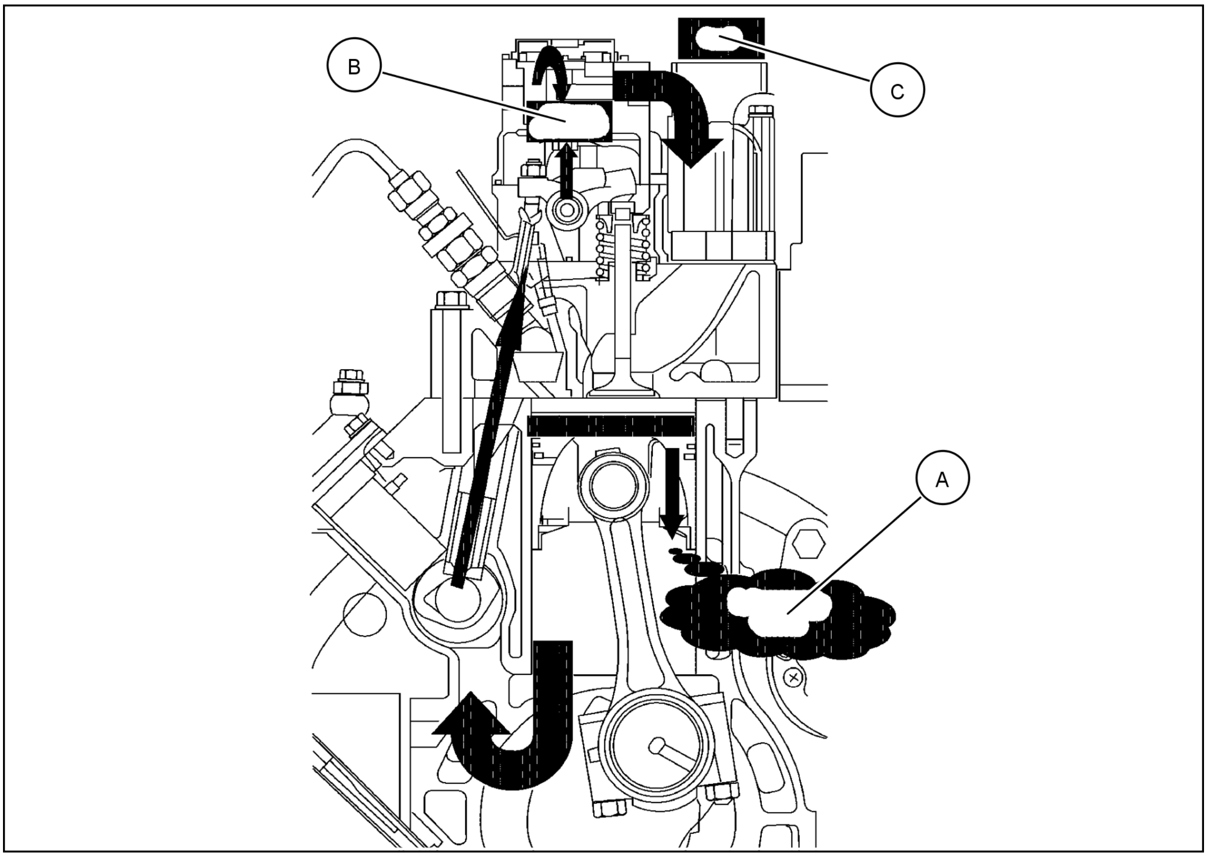
Blowby re-circulation system - Dynamic description Engine breather valve



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A - Blow-by gas
B - Oil mist separator
C - Valve

When the gas (created by combustion) passes through the piston ring, the gas is called "blow-by-gas".

When the crankcase pressure is less than **25 mm** Aq., the valve closes and the blow-by-gas is trapped in the crankcase.

The blow-by-gas flows into the oil mist separator and when crankcase pressure increases to approximately **25 mm** Aq. the valve opens. The valve opening allows blow-by-gas to pass into the intake manifold and be burned with the aspirated air.

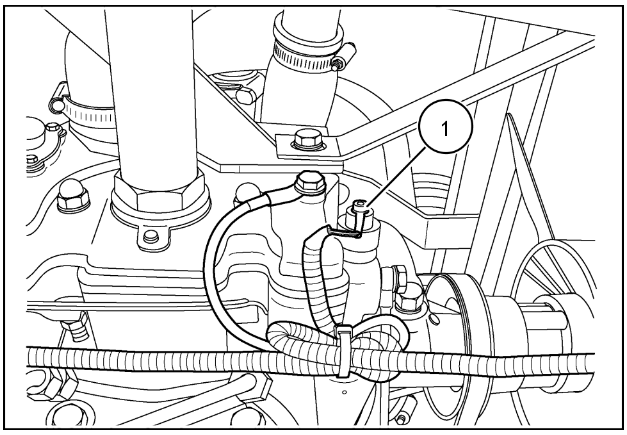
Therefore, the pressure inside of the crankcase must be maintained from **25 - 100 mm** Aq. so that the blow-by-gas can not be discharged into the air.

EPA Tier 2 requires the internal breather systems for all naturally aspirated engines, but not the turbocharged engines.

Sensing system - Dynamic description Engine oil pressure switch

The oil pressure sender, **(1)**, is located on the top front side of the engine. The switch opens under normal oil pressure (above **41 kPa** (**6 psi**)) and closes when oil pressure is low (below **41 kPa** (**6 psi**)) to complete the ground circuit of the oil pressure warning light.

When the ground circuit is completed, the oil pressure warning light illuminates on the instrument panel when the key switch is turned to the "ON" position and goes out when the engine is started. If the light does not go out after the engine has started, first check the engine oil level. If oil level is correct, check for a malfunctioning sender or engine oil pump.



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LUBRICATION SYSTEM - Check - Oil Consumption

Log oil consumption as follows:

1. Change the engine oil and filter. Use the oil specified in the operator’s manual.
2. Run the engine for 2 minutes.
3. Check the dipstick and add oil, if required, so the level is at the full mark.
4. Fill the fuel tank with fuel.
5. Record fuel consumption in liters (US gallons), oil added in liters (US gallons), and hour reading. Record fuel and oil use for 100 hours of operation, which is the recommended oil change interval. Check the dipstick before running the engine each day.

NOTE: *The maximum allowable oil consumption is* ***0.8 %****. The following table gives examples:*

Fuel Consumption	Oil Consumption	Percentage
189.27 l (**50 US gal**)	**1.5 l** (**1.6 US qt**)	**0.79 %**
378.54 l (**100 US gal**)	**3.03 l** (**3.2 US qt**)	**0.80 %**
757.08 l (**200 US gal**)	**6.06 l** (**6.4 US qt**)	**0.80 %**

6. If the oil consumption is greater than **0.8 %** of the fuel consumption, oil usage is excessive. A sample calculation for oil consumption follows:

   % consumption = (Quantity of Oil in Liters (US gallons)∕Quantity of Fuel in Liters (US gallons)) x 100

   Assume **0.25 l** (**0.07 US gal**) oil is added for **50 l** (**13.2 US gal**) fuel.

   % consumption = (**0.25 l∕50 l**) x 100 or (**0.07 US gal∕13.2 US gal**) x 100

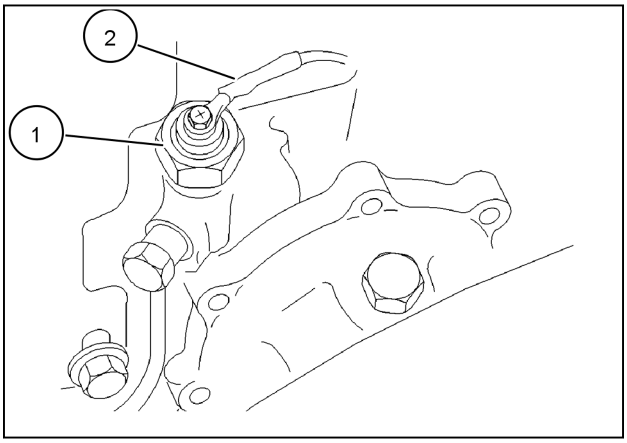
   % consumption = **0.5 %**.

LUBRICATION SYSTEM - Pressure test Engine oil

Prior operation:
Oil pump - Install (B.60.A),

Check

1. Disconnect the sending lead **(2)**, and remove the oil pressure sending unit **(1)**.



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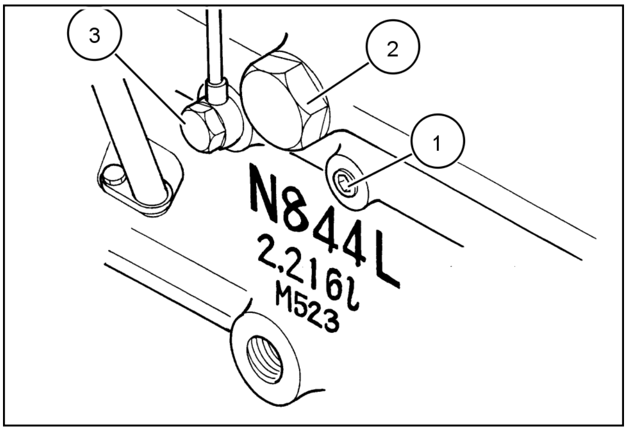
NOTE: *Main gallery access port* ***(1)****, located next to the relief valve* ***(2)****, and external oil tube* ***(3)****.*



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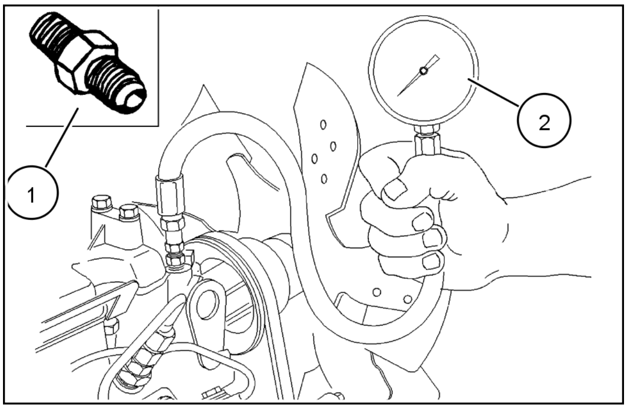
2. Install the oil pressure test fitting No. NH00011 **(1)**, and test gauge **(2)**. Start the engine and observe gauge indicator. Gauge should indicate between **98.04 - 147.07 kPa** (**14.22 - 21.33 psi**) at low idle and **244.76 - 343.36 kPa** (**35.5 - 49.8 psi**) at high idle.

NOTE: *Pressure test should be with engine at normal operating temperature.*

3. If the gauge did not indicate the oil pressure within specified tolerances at low and high idle, troubleshoot the lube oil system. See **ENGINE - Troubleshooting (B.10.A)**.



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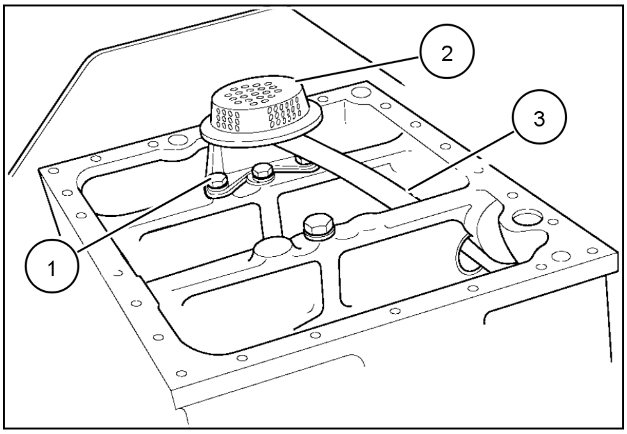
Oil pump - Remove - Suction pipe and strainer

Prior operation:
Oil pan - Remove (B.60.A).

1. Remove the retaining bolts **(1)**.
2. Remove the oil strainer **(2)**, and rotate the oil suction pipe **(3)**, out of its bore.



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Next operation:
Balancer - Remove (B.10.A).
Next operation:
Oil pump - Install Oil suction pipe and suction strainer (B.60.A).

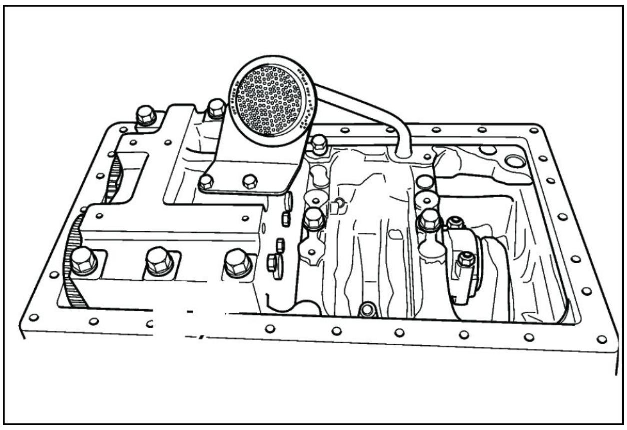
Oil pump - Install Oil suction pipe and suction strainer

Prior operation:
Balancer - Install (B.10.A).

1. Install a new O-ring on the suction pipe and rotate the suction pipe into its bore.
2. Install the suction strainer over the suction pipe and align the bolt holes.

NOTE: *If suction strainer bolt holes do not align, the suction pipe is either too far into its bore or not in far enough. Adjust as needed.*

3. Install the strainer retaining bolts and tighten to **8.8 - 12.9 N·m** (**6.5 - 9.5 lb ft**).



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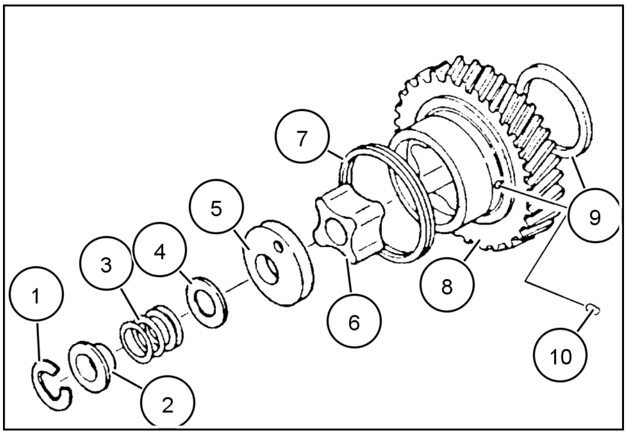
Next operation:
Oil pan - Install (B.60.A).

Oil pump - Remove

1. Drain the engine oil and remove the spin-on type oil filter.
2. Drain the radiator and remove the cooling fan and water pump assemblies. See: **Water pump - Remove (B.50.A)**.
3. Remove the timing gear cover. See: **Timing gear housing - Remove (B.10.A)**.
4. Remove the retaining ring **(1)**. Remove the idler gear **(8)**, and oil pump assembly **(1)**through **(10)**.



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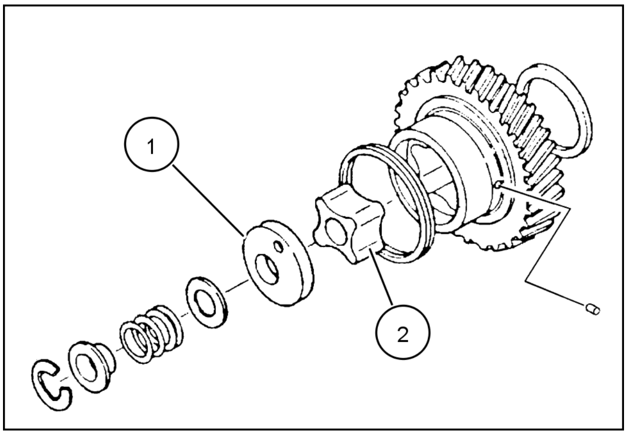
Next operation:
Oil pump - Inspect (B.60.A).

Oil pump - Inspect

Prior operation:
Oil pump - Remove (B.60.A).

1. Check for excessive wear on the pump cover **(1)**, and the port block. If port block requires replacement, see "Port Block Removal" discussed in **ENGINE - Disassemble (B.10.A)**.
2. Inspect the pump shaft and rotor **(2)**, for excessive wear or scratches.



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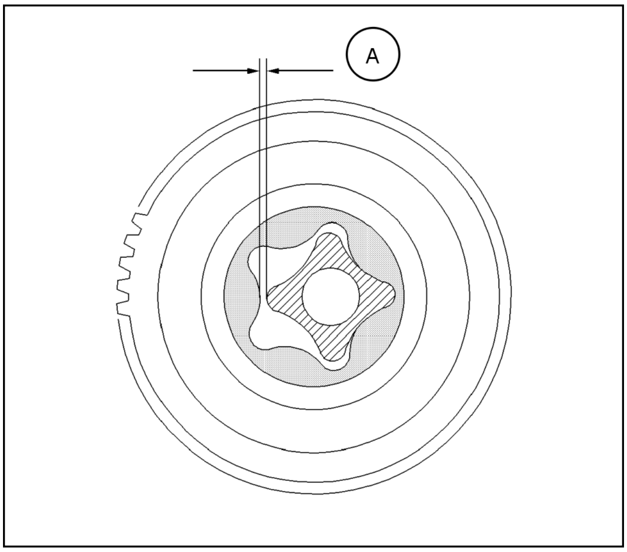
3. Measure the rotor to vane clearance. Replace the components as required, if clearance is not within specified tolerances.
   - Std.: **0.01 - 0.15 mm** (**0.004 - 0.006 in**).
   - Max.: **0.25 mm** (**0.010 in**).



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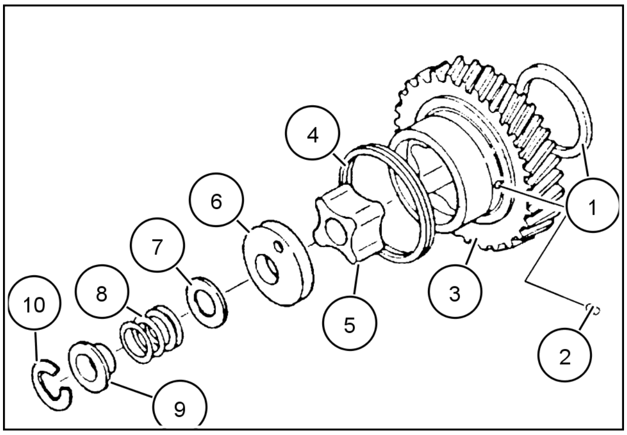
(A) Clearance

Next operation:
Oil pump - Install (B.60.A).

Oil pump - Install

Prior operation:
Oil pump - Inspect (B.60.A).

1. If the port block assembly was removed, install a new port block assembly. See "Port Block Assembly Installation" in **ENGINE - Assemble (B.10.A)**.
2. Install the thrust washer **(1)**, pin **(2)**, and align the set marks on the idler gear **(3)**, crankshaft gear, and camshaft gear, and install the idler gear on the port shaft.
3. Install the spring **(4)** and rotor **(5)**.
4. Install the oil pump cover **(6)**, shim **(7)**, spring **(8)**, and collar **(9)**. Secure the assembly to the shaft with the retaining ring **(10)**.



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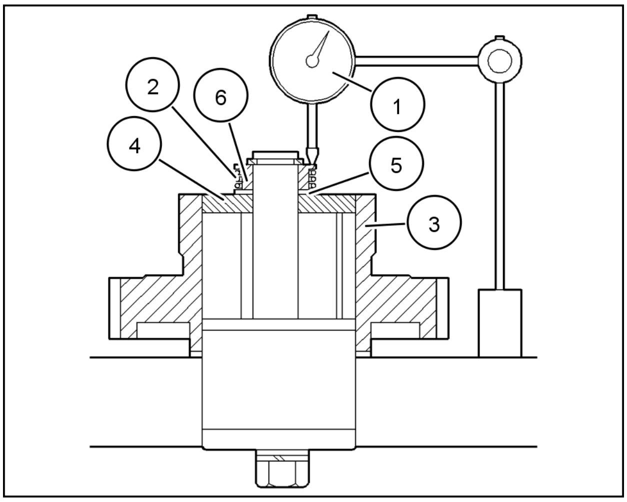
5. Using a dial indicator **(1)**, measure the axial movement of the collar **(6)**. The standard clearance is **0.01 - 0.15 mm** (**0.00039 - 0.0059 in**) and the maximum allowable is **0.2 mm** (**0.0079 in**). Install or remove shims **(5)** (PN SBA-199286340) as needed to obtain the standard clearance value.
6. Install the water pump and cooling fan assembly. See **Water pump - Install with cooling fan (B.50.A)**.
7. Install the timing gear cover. See **Timing gear housing - Install (B.10.A)**.
8. Refill the radiator to its proper coolant level.
9. Replace the engine oil filter and fill the sump with oil.



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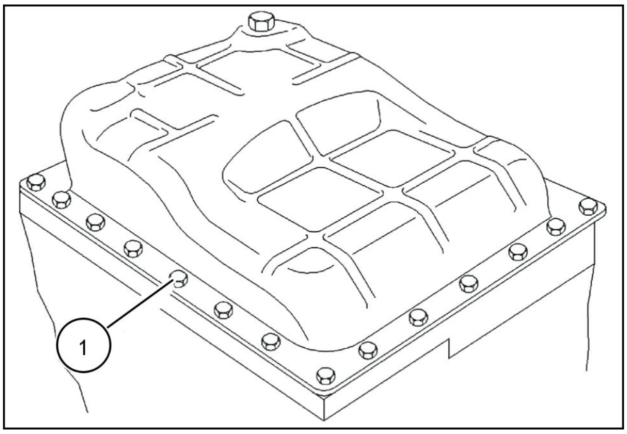
(1) Dial Indicator	**(4)** Oil Pump Cover
(2) Spring	**(5)** Shim
(3) Idler Gear	**(6)** Collar

Oil pan - Remove

Prior operation:
Timing gear - Remove - with camshaft (B.10.A).

NOTE: *The prior operation procedure refers to engine overhaul.*

1. Remove the oil pan retainer bolts **(1)**.
2. Remove the oil pan and discard gasket.



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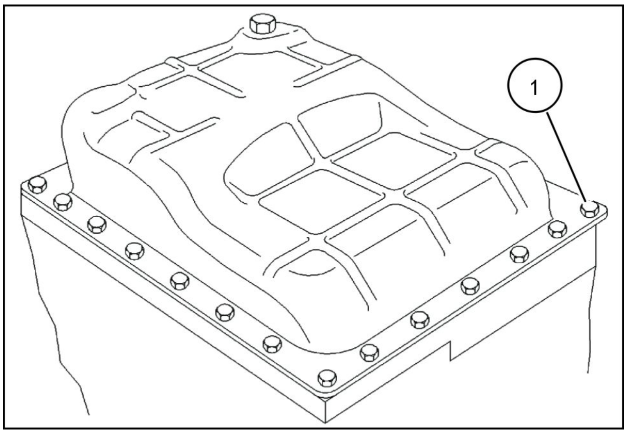
Next operation:
Oil pump - Remove - Suction pipe and strainer (B.60.A).
Next operation:
Oil pan - Install (B.60.A).

Oil pan - Install

Prior operation:
Oil pump - Install Oil suction pipe and suction strainer (B.60.A).

1. Apply a thin coat of gasket sealer to the oil pan sealing area.
2. Install a new gasket, the oil sump and the retaining bolts. Tighten the retaining bolts **(1)**, diagonally and evenly.



SECT10C0P72_2 1

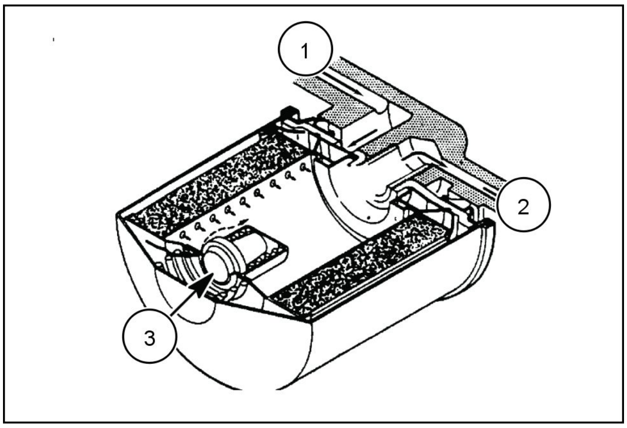
NOTE: *The next operation procedure refers to engine overhaul.*

Next operation:
Timing gear - Install Camshaft and gear (B.10.A).

Oil filter - Service instruction

Construction and Function

1. These engines utilize a cartridge type filter. Pressurized oil flow from the pump enters from **(1)**, and is filtered by a full flow filter before discharge through **(2)**. When the full flow filter is clogged, the safety valve **(3)**, opens to bypass the oil.



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Maintenance

2. The oil filter must be replaced every 100 hours of operation. When installing a new filter, coat its face with clean oil. Hand tighten only.

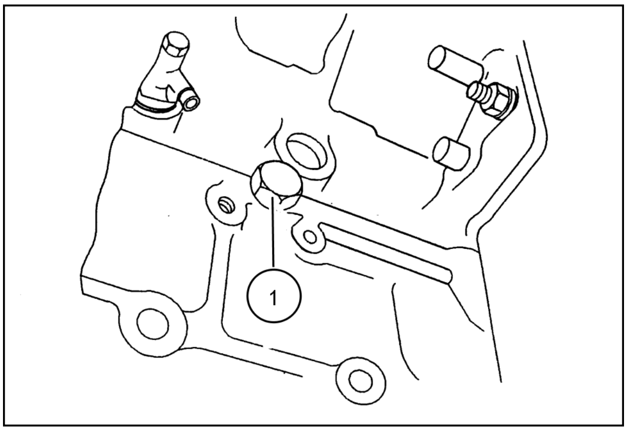
Oil pressure regulator valve - Service instruction

Prior operation:
LUBRICATION SYSTEM - Pressure test Engine oil (B.60.A).

Removal

1. Unscrew the oil pressure relief valve **(1)**, and remove from the block.

NOTE: *Pressure test should be with engine at normal operating temperature.*



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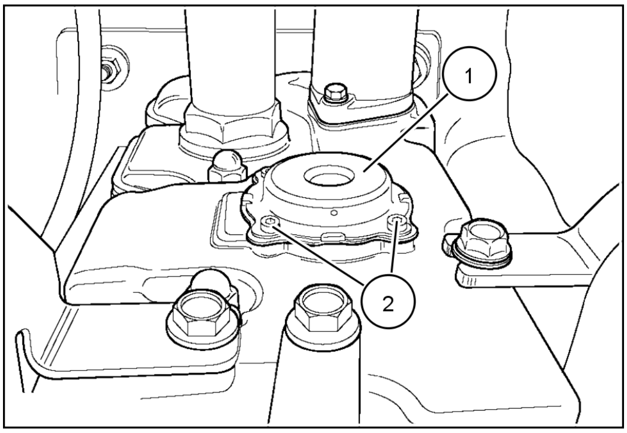
Installation

2. Install a new O-ring seal over the relief valve and screw the valve into the block. Tighten to **58.8 - 68.6 N·m** (**43.4 - 50.6 lb ft**).

Blowby re-circulation system - Remove Engine breather valve

The breather valve **(1)**, is located atop the head cover. Under the breather valve housing, is a diaphragm, that allows the engine to recirculate combustion gases, when the crankcase pressure builds.

1. Remove the screws, **(2)**, and pull breather valve, **(1)**, from head cover.



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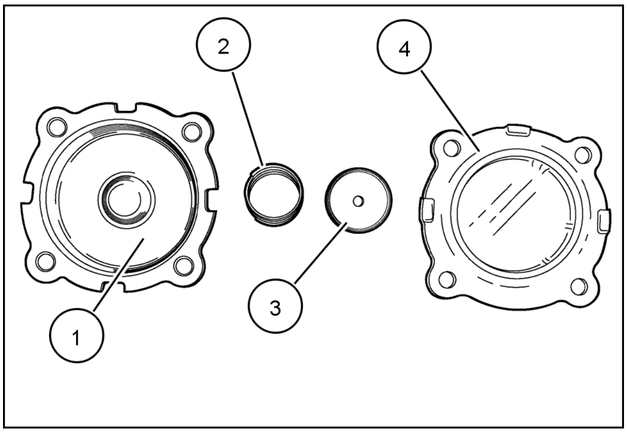
2. The breather valve consists of the following: Cover **(1)**, Spring **(2)**, Spring Retainer **(3)**, Diaphragm **(4)**.

NOTE: *The breather valve must be replaced as an assembly, not by individual pieces.*



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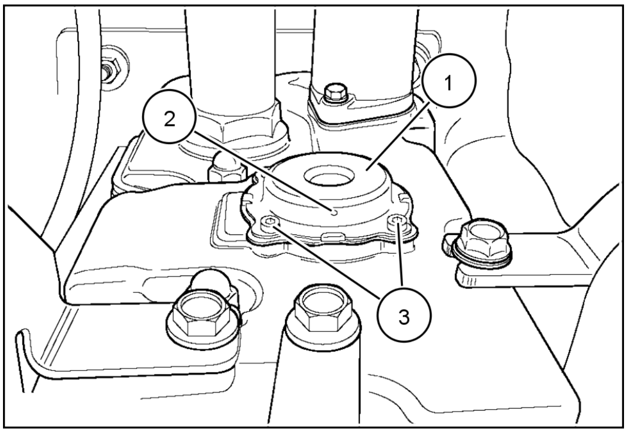
Next operation:
Blowby re-circulation system - Install Engine breather valve (B.60.A)

Blowby re-circulation system - Install Engine breather valve

Prior operation:
Blowby re-circulation system - Remove Engine breather valve (B.60.A)

1. Place breather valve, **(1)**, onto head cover. Make sure vent hole, **(2)**, is toward the front of the tractor, for easy access and fasten with four bolts, **(3)**.

NOTE: *Always keep small vent hole,* ***(2)****, free of oil and other debris, as to allow the crankcase, to vent properly*



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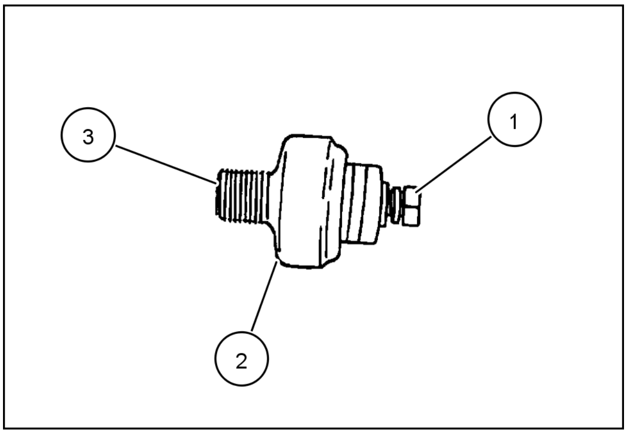
Sensing system - Test Engine oil pressure switch

1. Using an ohmmeter, touch one test lead to the pressure switch terminal, **(1)**, and the other test lead to the switch body, **(2)**.
2. Observe the ohmmeter. There should be little or no resistance, indicating continuity in the switch. If there is no continuity, the switch is defective and needs replaced.



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NOTE: *The following test is not a calibrated test. The purpose of the test is to see if the switch opens at pressure.*

1. While the test leads are connected to the switch, pressurize the switch oil pressure port, **(3)**, with low pressure (**69 - 207 kPa** (**10 - 30 psi**)) compressed air.
2. Observe the ohmmeter. While air pressure is being supplied to the oil pressure port, the ohmmeter should indicate high resistance, or no continuity. If there is continuity, the switch is defective and needs replaced.

Blowby re-circulation system - Troubleshooting

Problem	Possible Cause	Correction
Engine seals leaking oil	Excessive crankcase pressure. High pressure caused by breather valve not opening.	Inspect diaphragm for damage or contamination. Replace diaphragm if necessary.
	Vent hole in valve body plugged.	Remove valve body from engine and clean vent hole.
Engine emitting a bluish smoke	Excessive blow by gases of engine. Possible worn piston rings or scored cylinder walls.	Replace piston rings, hone cylinder walls to seat new rings.
	Engine breather valve is stuck in "OPEN" position. Valve diaphragm is damaged allowing valve not to close.	Replace engine breather valve diaphragm.
	Oil mist separator mesh screens allowing oil to enter intake manifold damaged or missing separator mesh screens.	Replace oil mist separator mesh screens.

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ENGINE AND PTO IN - B

STARTING SYSTEM - 80.A

Workmaster 45
Workmaster 55

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STARTING SYSTEM - 80.A

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Engine starter - General specification Starter motor

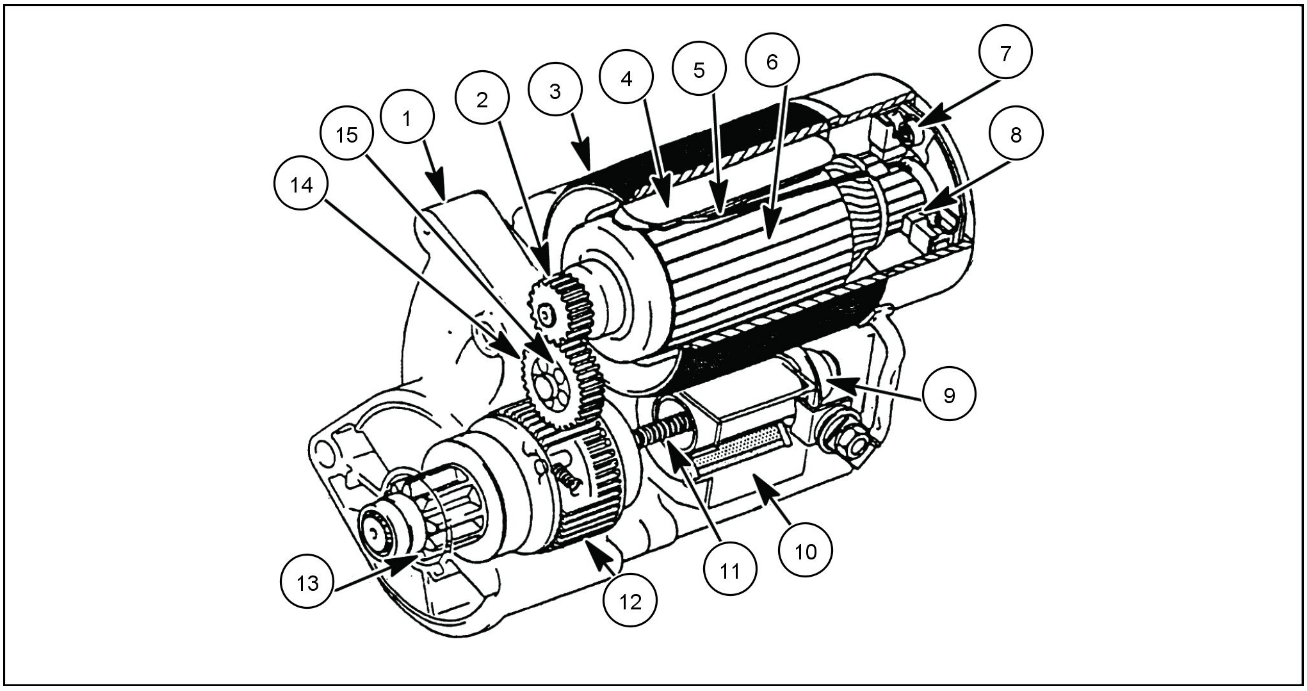
Manufacturer	Denso Corporation
Model	2288000-5120
Current Draw	
Under Load	**500 A @ 7.5 V**
No Load	less than **110 A**
No Load RPM	**4000 RPM**
No Load Voltage	**11.5 V**
Clutch System	Overrunning Pinion Clutch
Brush Length	
New	**15 mm** (**0.6 in**)
Wear Limit	**12 mm** (**0.5 in**)
Brush Spring Tension	**26 - 35 N** (**5.8 - 7.9 lb**)
Commutator Diameter	
New	**35 mm** (**1.4 in**)
Wear Limit	**34 mm** (**1.3 in**)
Commutator Insulation Depth	**0.2 - 0.85 mm** (**0.008 - 0.033 in**)
Armature Runout	
Commutator	**0.02 - 0.05 mm** (**0.001 - 0.002 in**)
Armature Shaft	**0.02 mm** (**0.001 in**)
Ratings time	30 Sec
Weight	**4.6 kg**

STARTING SYSTEM - Dynamic description

Description of operation

The starting system consists of a starter motor equipped with an electromagnetic starter solenoid, a key switch, a start relay, several safety switches, and heavy-duty wiring.

Starter Components



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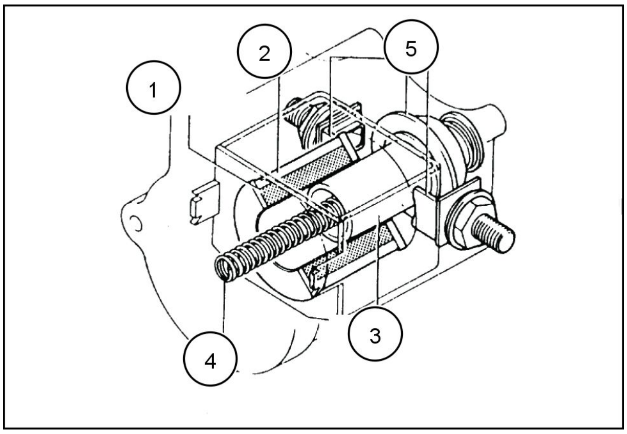
(1) Reduction Uni Cover
(2) Armature Drive Gear
(3) Motor/Field Coil Housing (Yoke)
(4) Permanent Magnet
(5) Field Coil
(6) Armature
(7) Brush Spring
(8) Brush
(9) Plunger
(10) Solenoid
(11) Return Spring
(12) Pinion Clutch
(13) Pinion
(14) Idler Gear
(15) Idler Gear Roller Bearing

Starter Motor Assembly

The starter motor features a high-speed motor that utilizes a gear reduction unit, an overrunning pinion clutch, **(12)**, and permanent magnets, **(4)**, in a field coil, **(5)**, for magnetic field induction. The reduction unit consists of a small drive gear, **(2)**, on the motor armature, **(6)**, which drives an idler gear, **(14)**, in the reduction unit. The idler gear is splined to the gear on the pinion clutch housing, **(12)**. When the starter solenoid, **(10)**, is energized, the solenoid plunger, **(9)**, pushes the pinion gear, **(13)**, out, engaging with the engine flywheel. The starter motor then is turning the flywheel, which rotates the engine. The use of the gear reduction unit allows use of the compact, high-speed motor and provides more torque and power to turn the engine flywheel. The sliding pinion mechanism is enclosed, resulting in a more durable mechanism.

Starter Solenoid

The starter solenoid is an electromagnetic type solenoid that is located on the bottom of the starter motor assembly. The solenoid contains two coils, a pull-in coil, **(1)** and a hold-in coil **(2)** When the key switch is turned to the "START" position and the safety start relay is closed (safety switches closed), current from the battery will energize the solenoid's two coils. With the coils energized, the solenoid plunger, **(3)** pushes a spring **(4)** which will then push the pinion gear out to engage the flywheel. At the same time, a set of contacts **(5)**, on the solenoid become closed, allowing current to flow to the starter motor. Closing the contacts also supplies current to both ends of the solenoid pull in coil which makes the coil become non-energized. The hold-in coil continues to engage the pinion gear with the flywheel.



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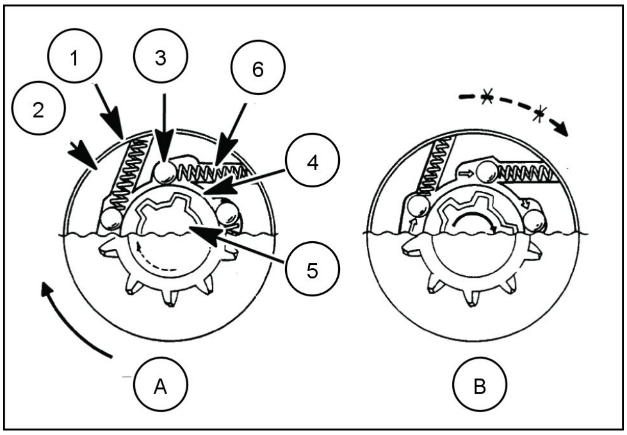
Pinion Clutch

To prevent the engine from driving the starter motor once the engine is running, the pinion gear is equipped with an overrunning clutch. The clutch will disengage the pinion gear from the rest of the starter components once the engine has been started and the key switch is in the "START" position. The clutch consists of an outer gear/shell, **(1)**, a cam with tapered notches, **(2)**, rollers, **(3)**, roller springs, **(4)**, a splined pinion collar/tube that acts as a clutch hub, **(5)**, and the pinion shaft, **(6)**. As the starter motor engages and rotates, the rollers are locked against the pinion collar with the tension provided by the roller springs. While the rollers are locked, the clutch assembly is locked, allowing the pinion gear to rotate the flywheel. When the engine starts, the flywheel moves faster than the starter motor and this causes the rollers to become unlocked. With the rollers unlocked, the clutch assembly is unlocked, allowing the pinion gear and shaft to turn independently of the starter motor.



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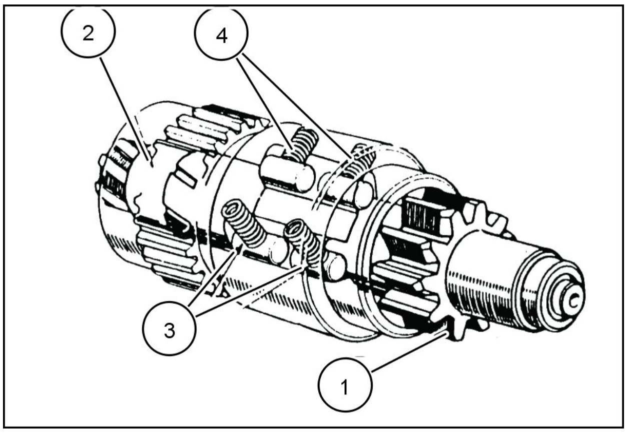
A - Engaged, B - Disengaged

(1) Clutch Gear
(2) Cam
(3) Roller
(4) Spline Tube - Inner (Pinion Collar)
(5) Pinion Shaft
(6) Roller Spring

The clutch is not serviceable and is replaced as a complete assembly.

Once the engine is started and the key switch is released from the "START" position, the solenoid's pull in coil becomes energized, pulling the solenoid plunger in, which disengages the pinion from the flywheel.



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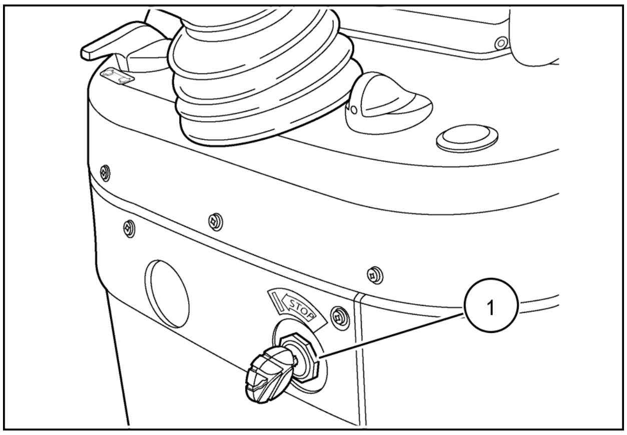
Engine starter - Static description Key Switch

The key switch, **(1)**, is located on the right side of the operator’s console. The four positions of the key switch are:

- OFF
- ACCESSORY/RUN
- ENGINE PREHEAT
- START

NOTE: *All positions are in a clockwise rotation. From "OFF," the "START" and "ENGINE PREHEAT" positions are spring loaded to return to "ACCESSORY / RUN."*



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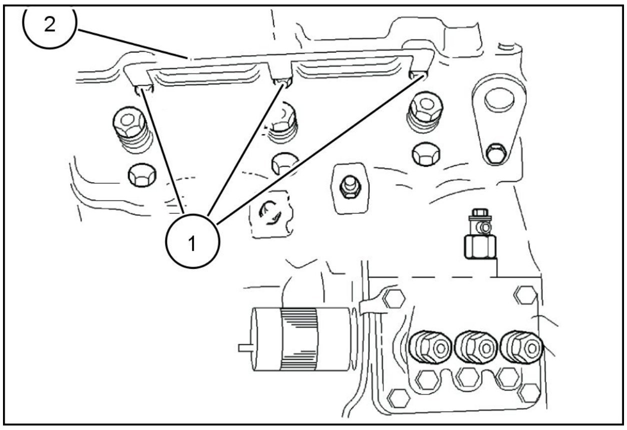
Cold start aid - Install Glow plug and connector

Prior operation:
Water pump - Install with cooling fan (B.50.A).

NOTE: *The prior operation and next operation procedures refer to engine overhaul.*

1. Install the glow plugs **(1)**, and torque to **15 - 20 N·m** (**11 - 14.5 lb ft**).
2. Install the glow plug connector **(2)**.



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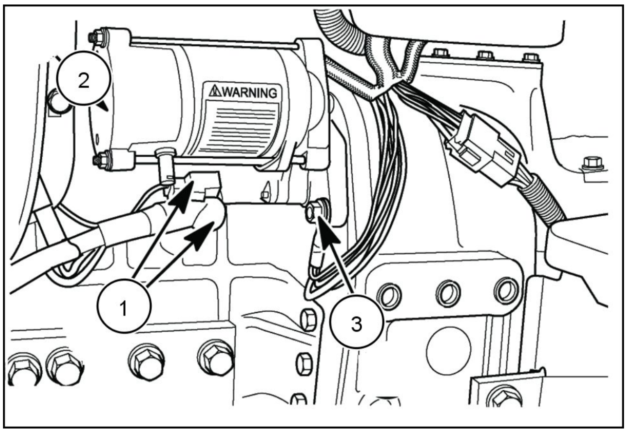
Next operation:
Fuel injector - Install (B.20.A).

Engine starter - Remove

Prior operation:
Engine starter - Troubleshooting (B.80.A)

1. Disconnect the negative (-) battery cable from the battery.
2. Disconnect the wiring harness connections **(1)**, from the starter motor **(2)**.
3. Remove the bolts, **(3)**, which secure the starter assembly, **(1)**, to the tractor engine.



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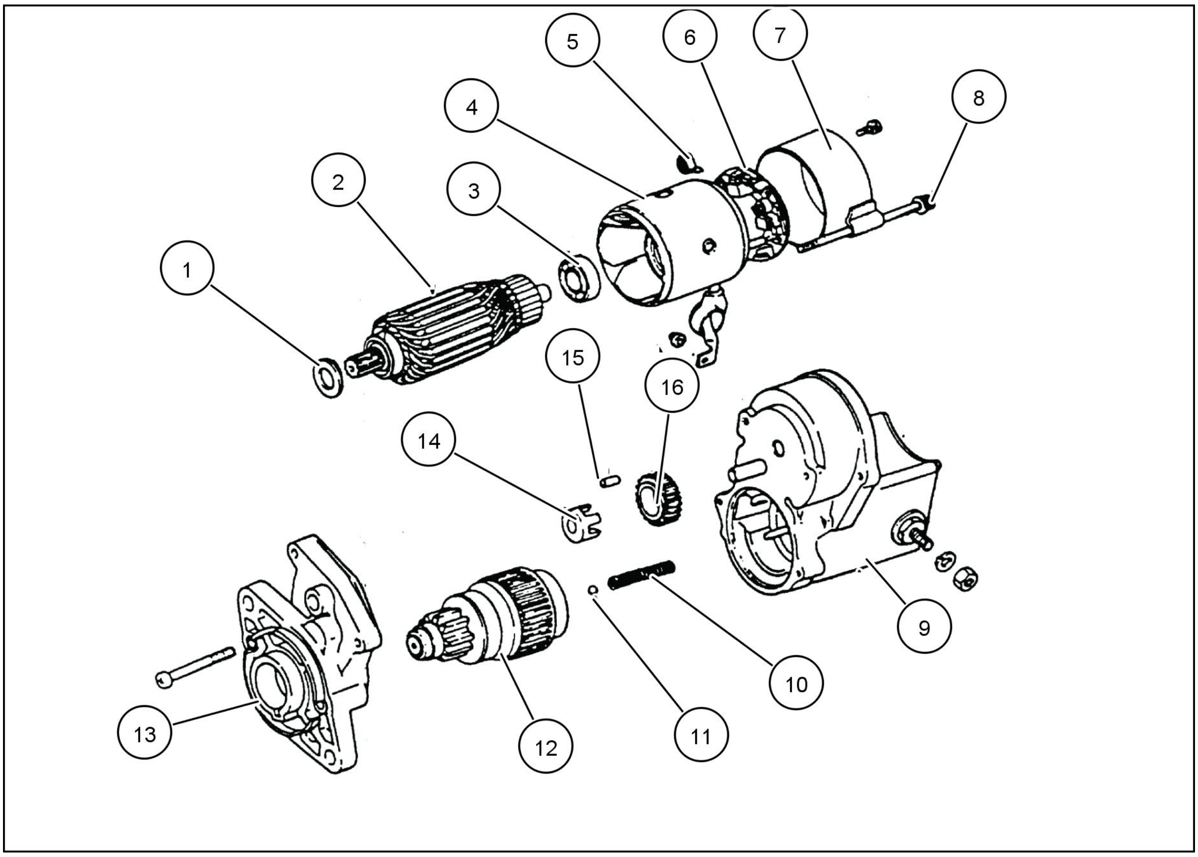
Next operation:
Engine starter - Disassemble Starter motor (B.80.A)

Engine starter - Disassemble Starter motor

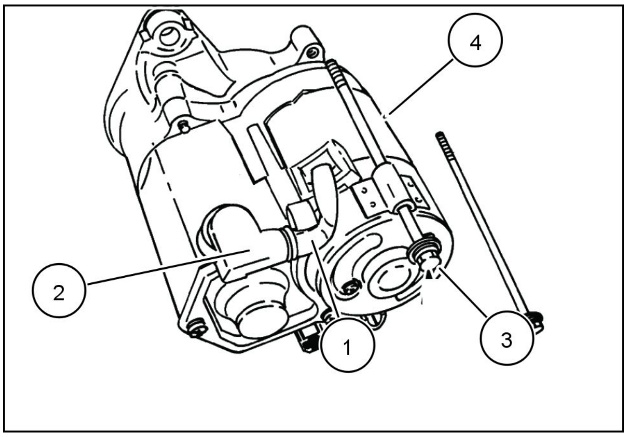


SEC55CH4PG30_2 1

Prior operation:
Engine starter - Remove (B.80.A)

- **(1)** Felt Washer
- **(2)** Armature (with Front Bearing)
- **(3)** Rear Armature Bearing
- **(4)** Motor/Field Coil Housing
- **(5)** Brush Spring
- **(6)** Brush Holder
- **(7)** Brush Cover
- **(8)** Through Bolt
- **(9)** Solenoid Housing
- **(10)** Return Spring
- **(11)** Steel Ball
- **(12)** Pinion Clutch
- **(13)** Reduction Unit Housing
- **(14)** Idler Gear Roller Bearing
- **(15)** Roller
- **(16)** Idler Gear

1. Remove the field coil wire, **(1)**, the solenoid terminal **(2)**.
2. Remove the long through bolts, **(3)**, securing the motor assembly **(4)**, to the gear reduction unit housing.



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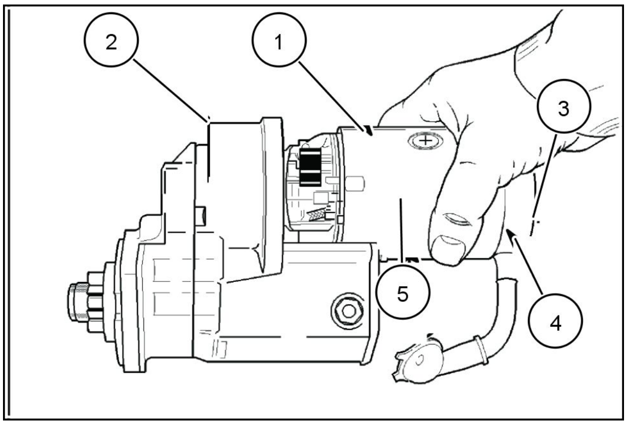
3. Slide the motor assembly, **(1)**, from the gear reduction unit housing **(2)**.
4. Remove the screws, **(3)**, which secure the brush cover **(4)**, to the motor/field coil housing **(5)**.



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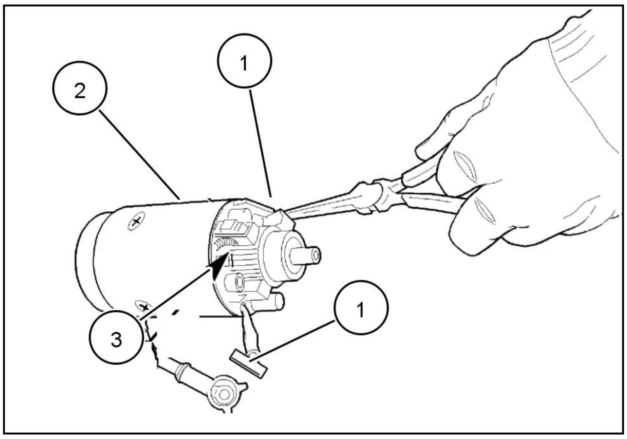
NOTE: *Before removing the brush holder scribe aligning marks on the brush holder and the motor/field coil housing.*

5. Use a suitable pair of pliers to remove the insulated armature commutator brushes **(1)**, from the brush holder **(2)**.
6. Slide the brush holder, **(2)**, from the armature commutator **(3)**.



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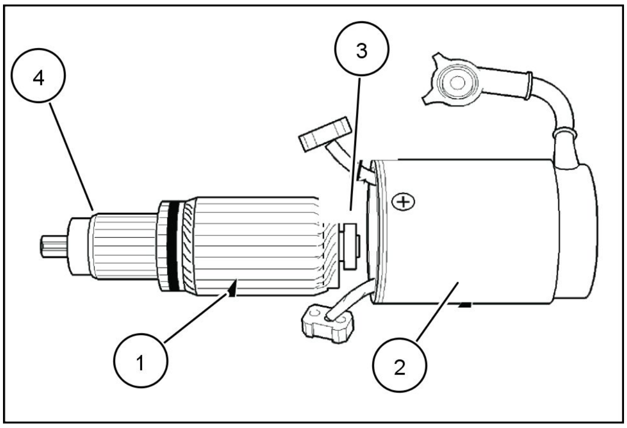
7. Remove the armature, **(1)**, from the motor/field coil housing, **(2)**. The rear armature bearing, **(3)**, is a light press fit and it may be necessary to pull the armature from the housing, gripping on the front bearing, **(4)**.



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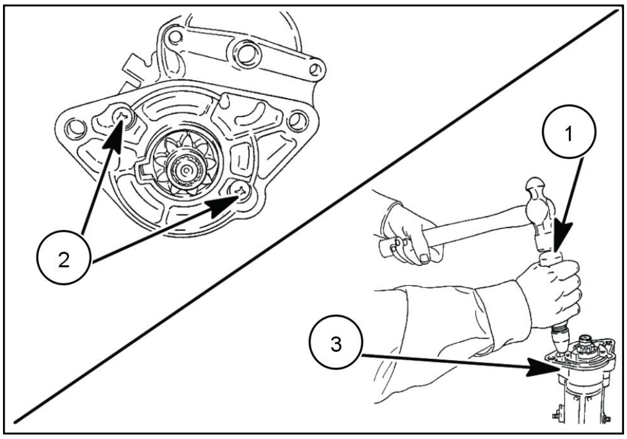
8. Use an impact tool, **(1)**, remove the two screws, **(2)**, securing the gear reduction cover, **(3)**, to the starter housing.



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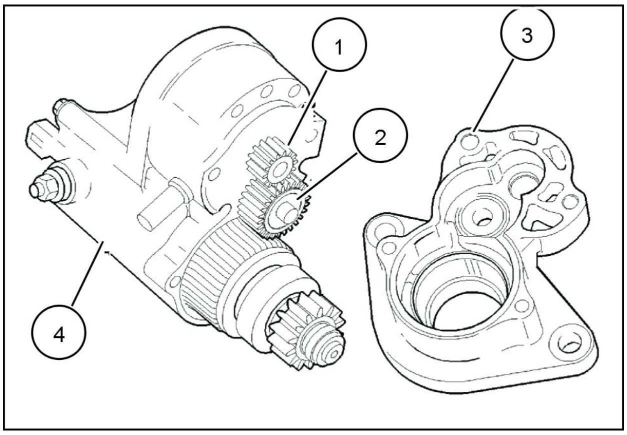
NOTE: *The pinion gear,* ***(1)****, and idler gear with roller bearings,* ***(2)****, will be free to fall out when the gear reduction unit cover,* ***(3)****, is removed from the starter assembly,* ***(4)****. Use care not to lose any of these pieces.*

9. Carefully remove the reduction unit cover, **(3)**, from the starter assembly, **(4)**.



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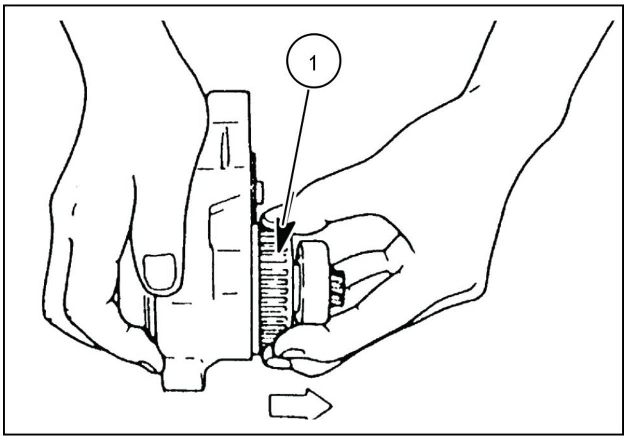
10. Pull the pinion clutch assembly, **(1)**, from the reduction unit cover or the starter motor assembly.



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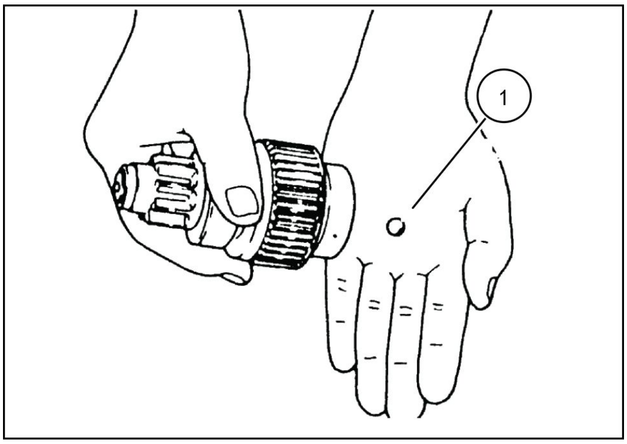
11. Remove the steel ball, **(1)**, from the center of the pinion clutch.



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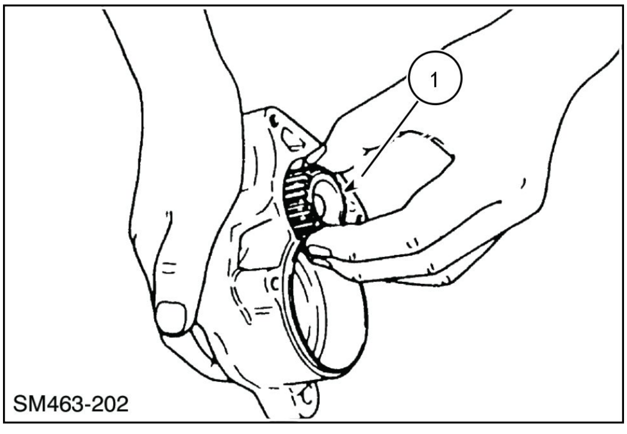
NOTE: *When removing the idler gear and bearing, be careful not to lose the bearing rollers contained in the bearing.*

12. Remove the idler gear and bearing, **(1)**, and pinion gear from the reduction unit cover, if they were not removed when the reduction unit cover and the starter motor housing was separated.



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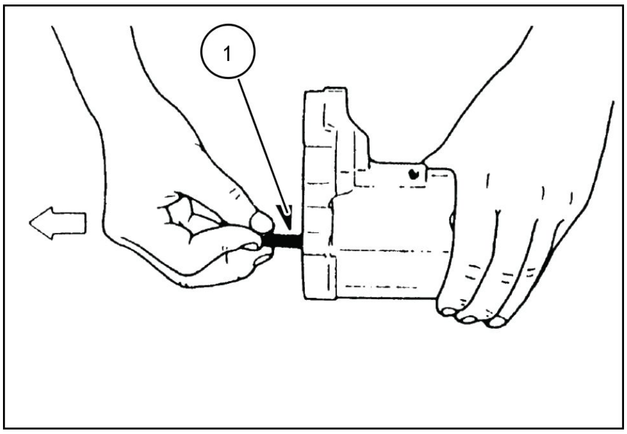
13. Remove the return spring **(1)**, from the electromagnetic solenoid.



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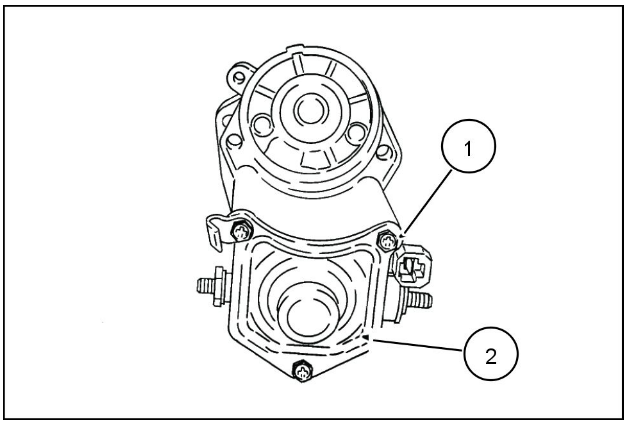
14. Remove the screws, **(1)**, securing the solenoid cover **(2)**, to the starter housing. Pry the cover from the housing.



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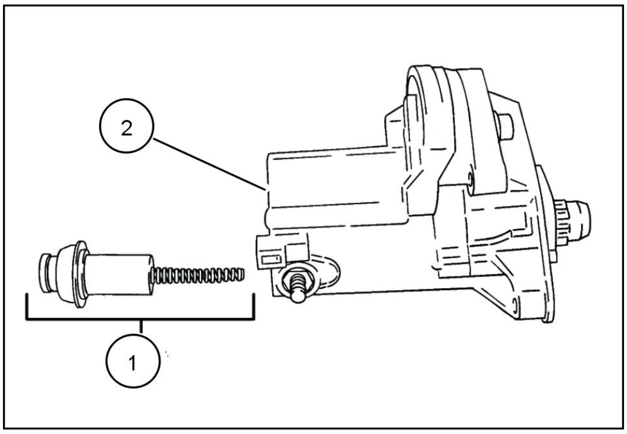
15. Remove the solenoid plunger and spring assembly, **(1)**, from the starter housing **(2)**.



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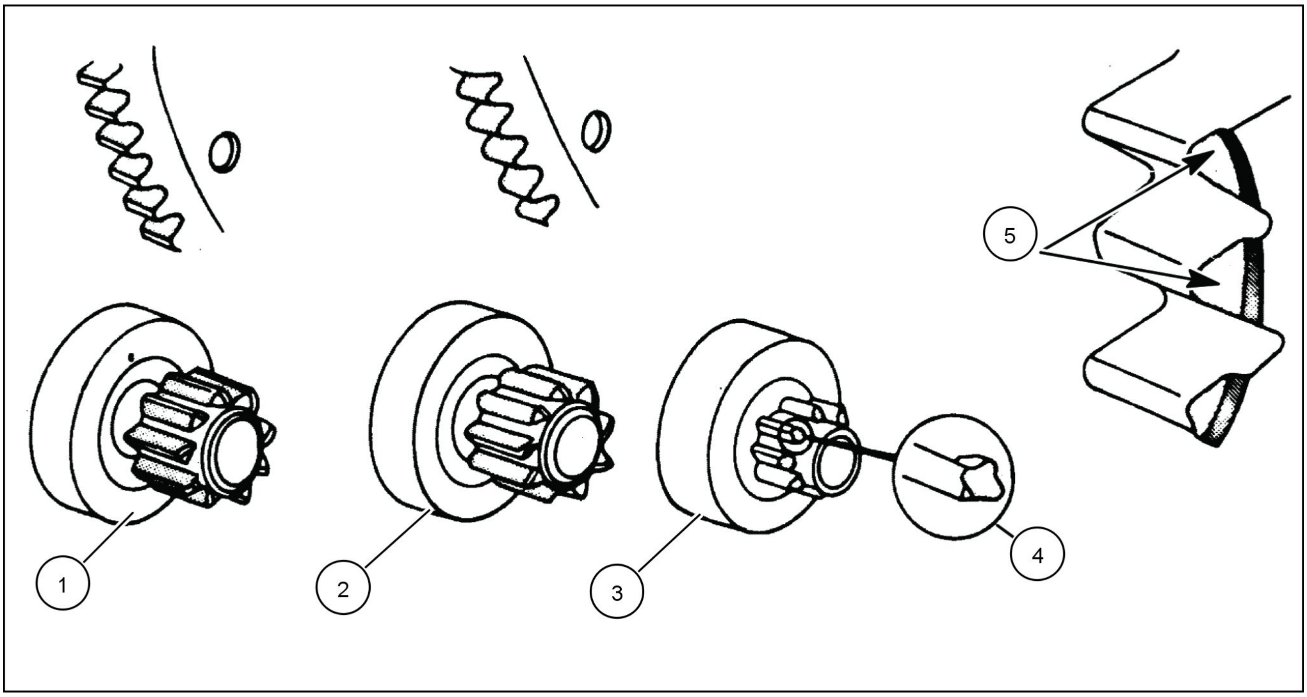
Next operation:
Engine starter - Inspect Starter motor (B.80.A)

Engine starter - Inspect Starter motor

Prior operation:
Engine starter - Disassemble Starter motor (B.80.A)



SEC55CH4PG35 1

(1) Normal Wear Pattern

(2) Small Wear Pattern

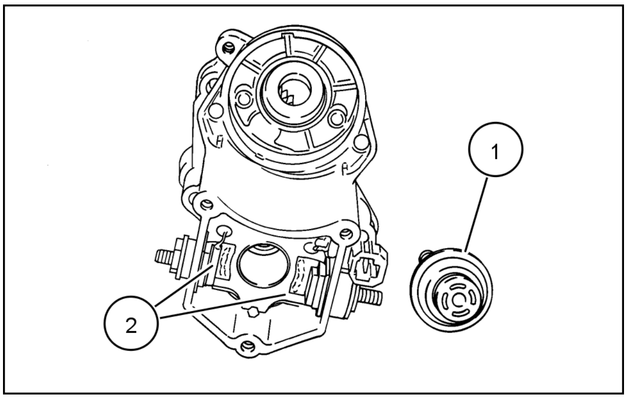
(3) Milled Gears

(4) Milled Tooth-Metal Buildup - Will Not Permit Engagement

(5) Milled Condition Excessive Wear On 2 Or 3 Teeth.

1. Inspect the gear splines on the pinion clutch, the pinion, the armature, and the intermediate gear for damaged or missing splines. Replace any damaged parts.
2. Hold the pinion clutch housing and rotate the pinion. The pinion should rotate smoothly, although not necessarily easily, in one direction only. If the pinion can spin in both directions, the clutch is defective and needs replaced.
3. Inspect the motor housing, brush cover, gear reduction unit, and starter housing for damage such as cracks, fatigue, wear, etc. Replace any damaged parts.
4. Inspect the brush terminals, battery terminals, and motor terminals for corrosion, loose connections or damage. Repair or replace any damaged parts.

5. Clean and inspect the solenoid plunger contact ring, **(1)** and solenoid contacts **(2)**. Dirty contacts or pitting may be cleaned with fine grit sandpaper or a fine abrasive pad.
6. Inspect that all bearings rotate freely when rotated manually by hand and are not damaged or have excessive play. Replace any damaged bearings.



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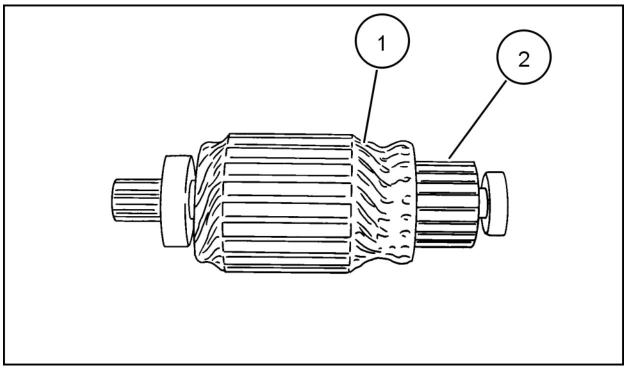
7. Inspect the armature windings **(1)**, for burnt, broken or loose connections.
8. Inspect the commutator contacts **(2)** for burnt segments, indicating an open winding.



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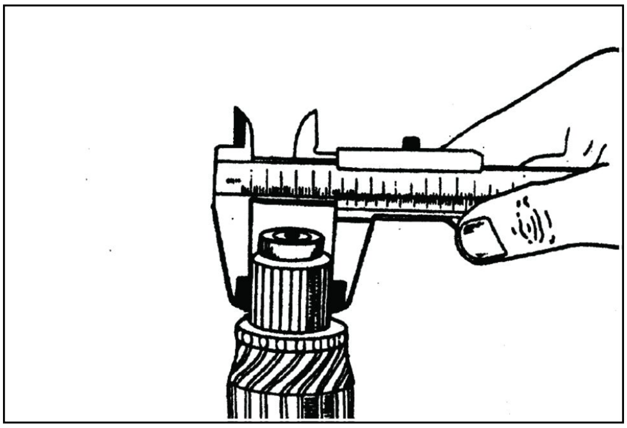
9. Use a suitable measuring device to measure the commutator diameter. The minimum commutator diameter is **34.0 mm** (**1.339 in**). If the commutator is worn beyond these specifications, replace the armature.



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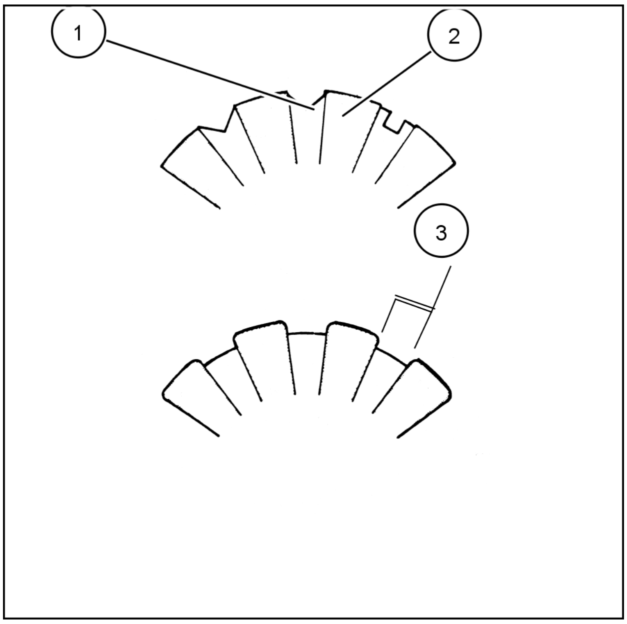
10. Inspect the mica insulating valleys, **(1)** between the commutator contacts **(2)** for uneven wear. Use a suitable measuring device to check the distance, **(3)** between the top of the contact to the bottom of the insulating valley. The distance should be **0.5 - 0.8 mm** (**0.020 - 0.031 in**). If the distance is not within these specifications or there is uneven wear, the insulating valleys may be undercut with a suitable file.



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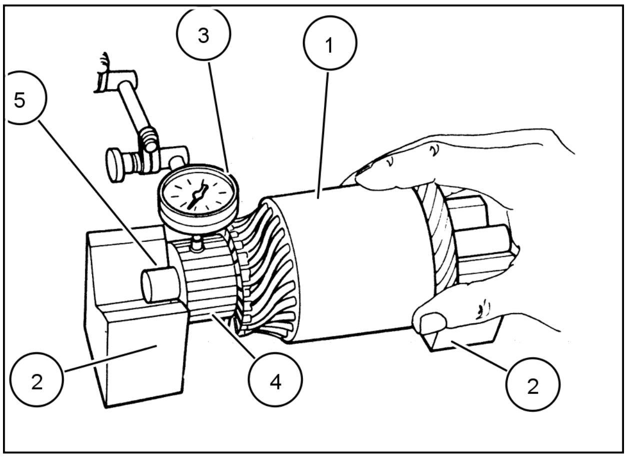
NOTICE: *If not previously removed, the armature bearings will need to be removed for this test.*

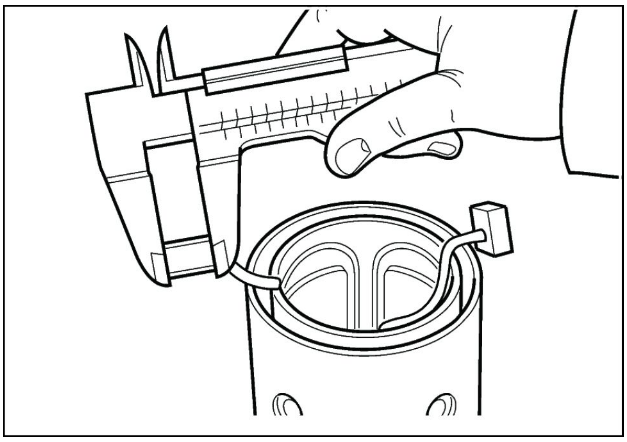
11. Place the armature, **(1)** in a set of precision V-blocks **(2)** and use a dial indicator, **(3)** measure commutator **(4)** runout and shaft **(5)** runout. Commutator runout should not be more than **0.2 mm** (**0.008 in**). Shaft runout should not be more than **0.5 mm** (**0.002 in**)



20002266 6

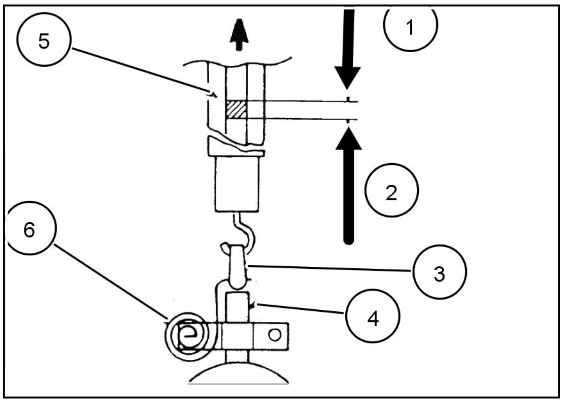
NOTICE: *When measuring the brush length, remove the brush from the brush support and measure the middle portion of the brush.*

12. Use a suitable measuring device to measure the length of the armature brushes. Compare the measurement of each brush with brush length specifications. If the brush is not within specifications or is damaged in any way, replace the brushes.



SEC55CH4PG37_3 7

13. Test the brush spring tension by connecting a spring balance to the brush spring and pulling until the spring moves. Observe the reading indicated on the spring balance. If the reading is between **26 - 35 N** (**5.8 - 7.9 lb**), the spring tension is within specifications. Otherwise, replace the brush springs



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Standard Tension = (1) 26 N (5.8 lb) to (2) 35 N (7.9 lb)

(3) Hook, (4) Brush, (5) Spring Scale, (6) Brush Spring.

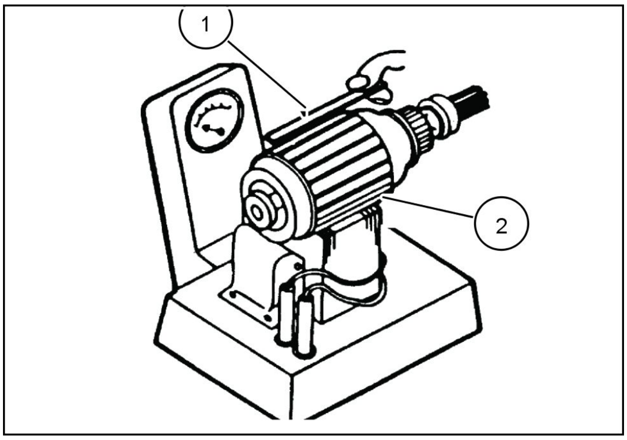
Next operation:
Engine starter - Electrical test Starter motor (B.80.A)

Engine starter - Electrical test Starter motor

Prior operation:
Engine starter - Inspect Starter motor (B.80.A)

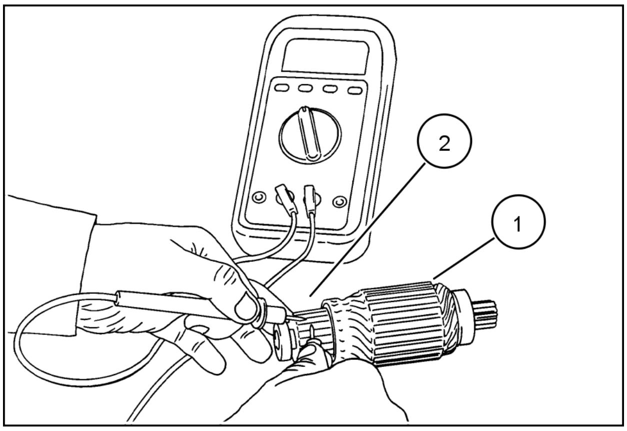
Armature

1. Use a growler **(1)** to inspect the armature coil **(2)** for short circuits. Replace if the armature is shorted.



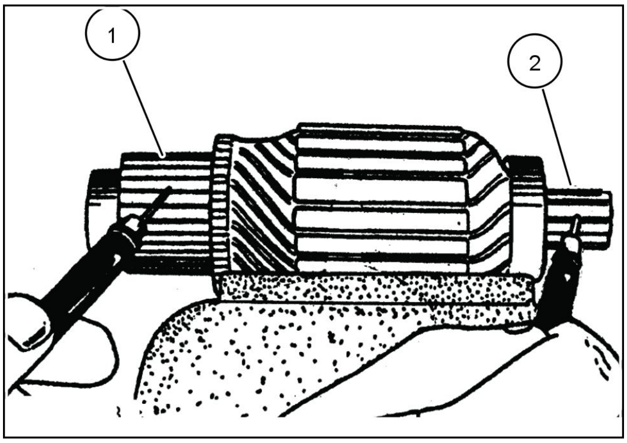
SEC55CH4PG38_2 1

2. Use an ohmmeter to test for continuity in the armature coil **(1)**.
3. Touch one ohmmeter test probe to a commutator contact **(2)**. Touch the ohmmeter test probe to an adjacent commutator contact.
4. Observe the ohmmeter. Repeat the test on each adjacent commutator contact. Little or no resistance indicates that there is continuity and the armature coil is good. High resistance indicates that the armature is defective and needs replaced.



20002280 2

5. If the armature is tested OK, touch one ohmmeter test probe to a commutator contact **(1)**. Touch the other test probe to the armature shaft **(2)**.
6. Observe the ohmmeter. A high resistance reading indicates the armature is good. Little or no resistance indicates that the armature is defective and needs to be replaced.



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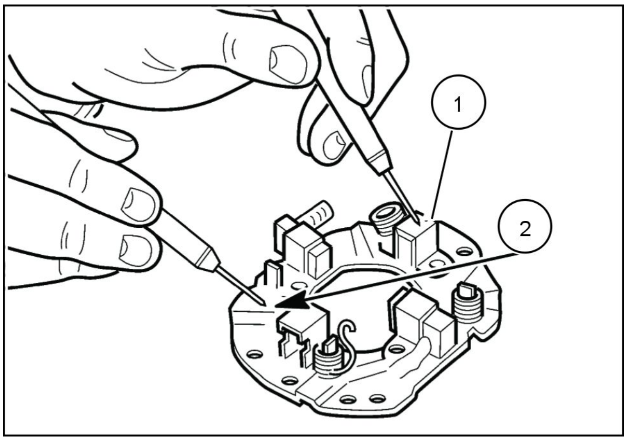
Brush Holder

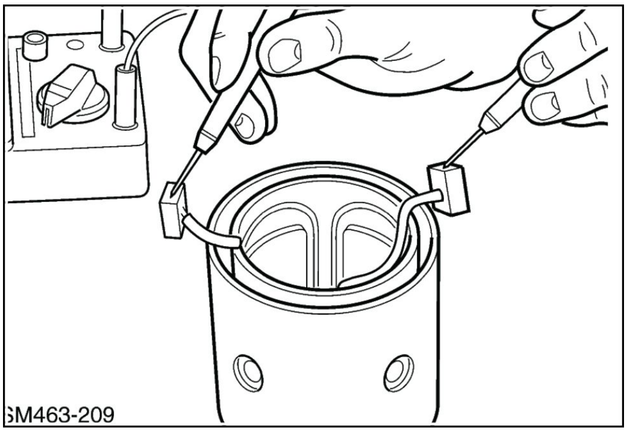
7. Using an ohmmeter, touch one test probe to the insulated brush holder **(1)** and the other test probe to the brush holder plate **(2)**
8. Observe the ohmmeter. Repeat the test for the opposite insulated brush holder.
9. A reading high resistance indicates no continuity and the brush holder is good. Little or no resistance indicates that there is continuity and the brush holder is defective and needs replaced



SEC55CH4PG39_2 4

Field Coil

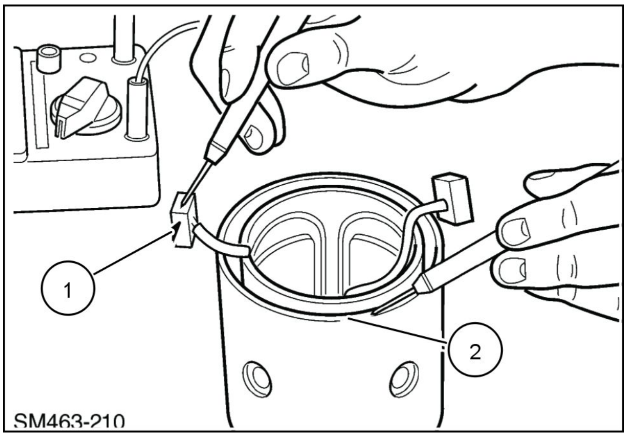
10. Use an ohmmeter to test the field coil.
11. Touch one ohmmeter test probe to one of the field coil brushes. Touch the other test probe to the remaining field coil brush.
12. Observe the ohmmeter. Little or no resistance indicates continuity and that the field coil is functioning properly. High resistance indicates the field coil is defective and needs replaced.



SEC55CH4PG39_3 5

NOTICE: *Paint on the field coil/motor housing will give a false reading when testing to see if the field coil is grounded. Be sure to remove paint from the field coil/motor housing.*

13. If the previous test indicated the field coil was not defective, touch one ohmmeter test probe to one of the field coil brushes **(1)**. Touch the other test probe to the field coil housing **(2)**.
14. Observe the ohmmeter. If the reading shows high resistance, indicating no continuity, the field coil is not grounded and is functioning properly. If there is little or no resistance indicating continuity, the field coil is defective and needs replaced.

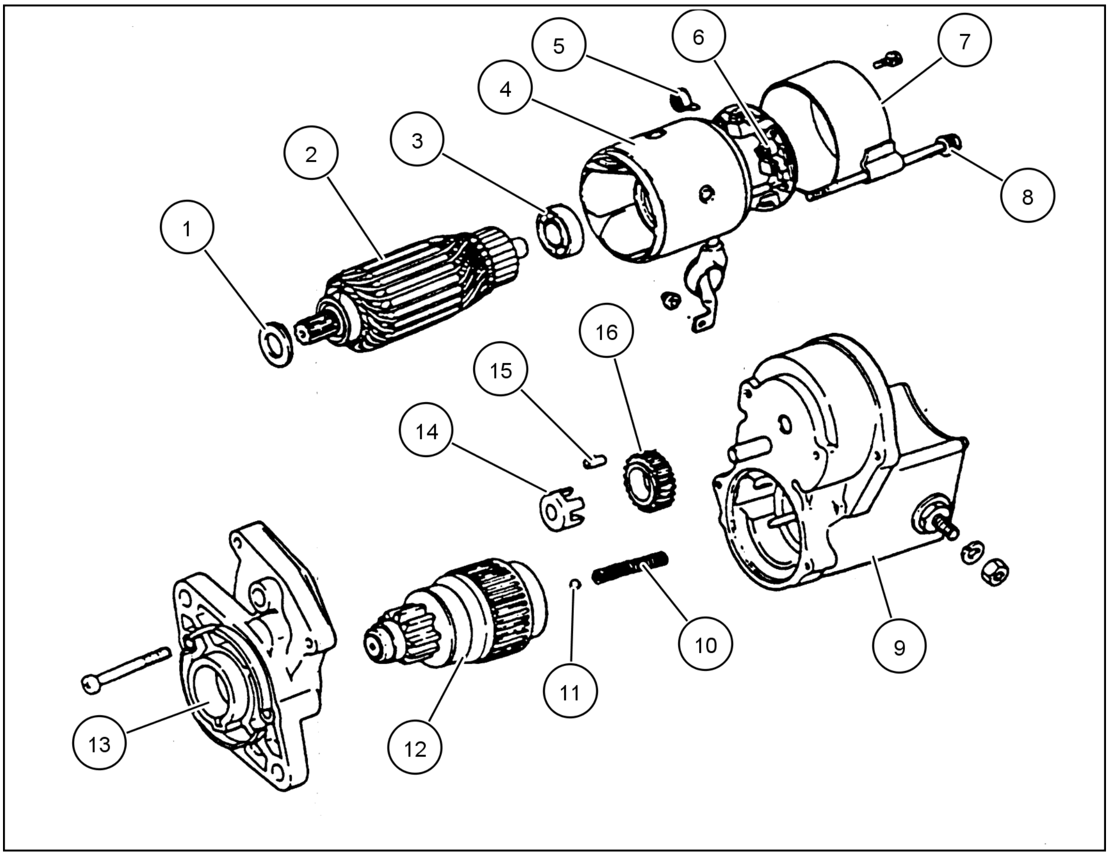


SEC55CH4PG40_1 6

Next operation:
Starter solenoid - Electrical test (B.80.A)

Engine starter - Assemble Starter motor

Prior operation:
Starter solenoid - Electrical test (B.80.A)



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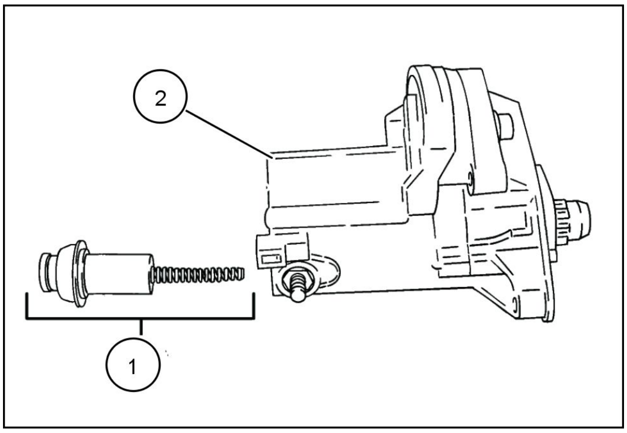
(1) Felt Washer	**(9)** Solenoid Housing
(2) Armature (with Front Bearing)	**(10)** Return Spring
(3) Rear Armature Bearing	**(11)** Steel Ball
(4) Motor/Field Coil Housing	**(12)** Pinion Clutch
(5) Brush Spring	**(13)** Reduction Unit Housing
(6) Brush Holder	**(14)** Idler Gear Roller Bearing
(7) Brush Cover	**(15)** Roller
(8) Through Bolt	**(16)** Idler Gear

NOTE: *Use white lithium grease to lubricate parts indicated.*

1. Install the solenoid plunger, **(1)**, to the starter housing, **(2)**



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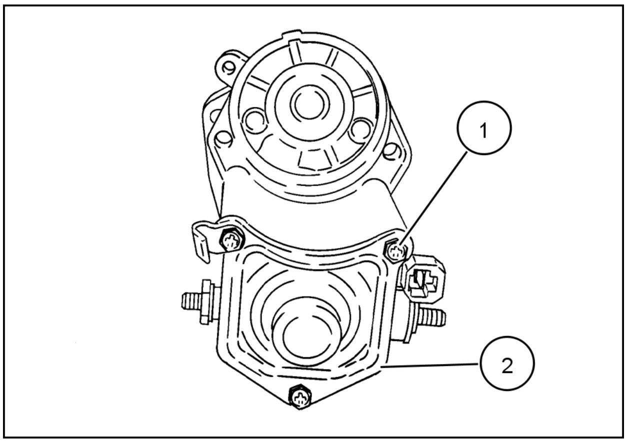
2. Install the solenoid cover and gasket to the starter housing. Install the screws, **(1)**, securing the solenoid cover, **(2)**, and gasket to the starter housing.



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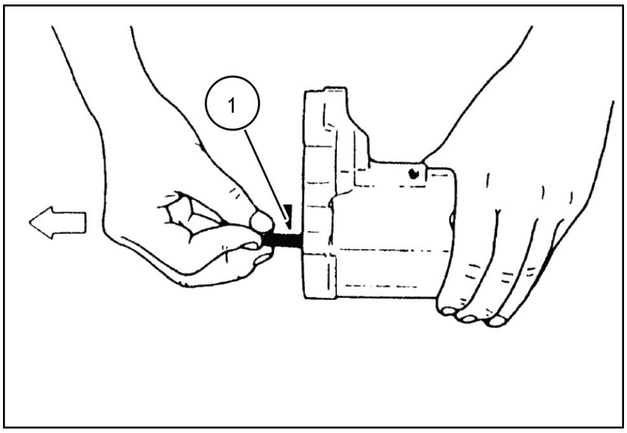
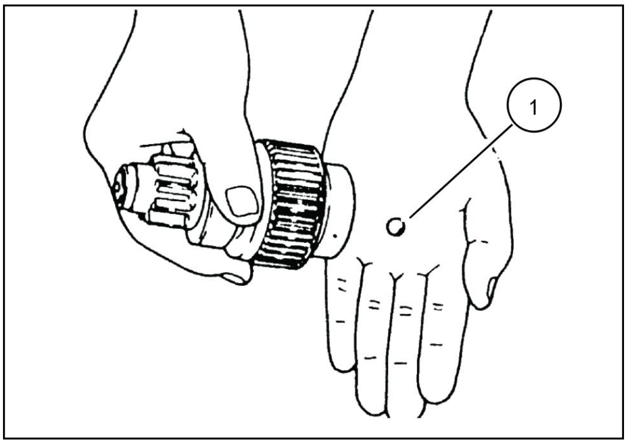
3. Grease and install the return spring, **(1)**, to the solenoid.



SEC55CH4PA34_1 4

4. Grease and install the steel ball, **(1)**, into the center of the pinion clutch.



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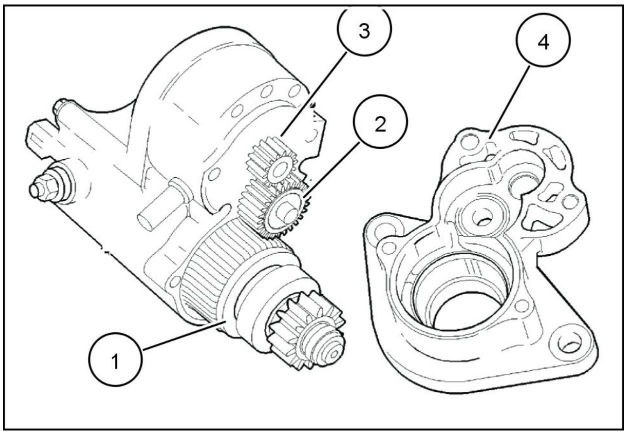
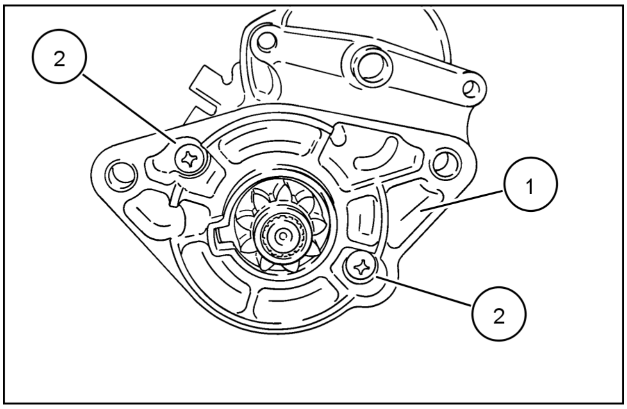
5. Grease and install the pinion clutch, **(1)**, in the starter housing. Make sure the rear clutch bearing is completely seated in the housing.
6. Grease the idler gear bearing and gear and install the gear, **(2)**, and bearing onto the starter housing. Align the bearing and gear so that it meshes with the pinion clutch and is aligned with the hole in the housing for the pin which the bearing rides on.
7. Install the drive gear, **(3)**, in the proper recess in the reduction unit cover, **(4)**, as the cover is being installed onto starter motor housing.



SEC55CH4PA32_3 6

8. Secure the gear reduction cover, **(1)**, with the retaining screws, **(2)**.



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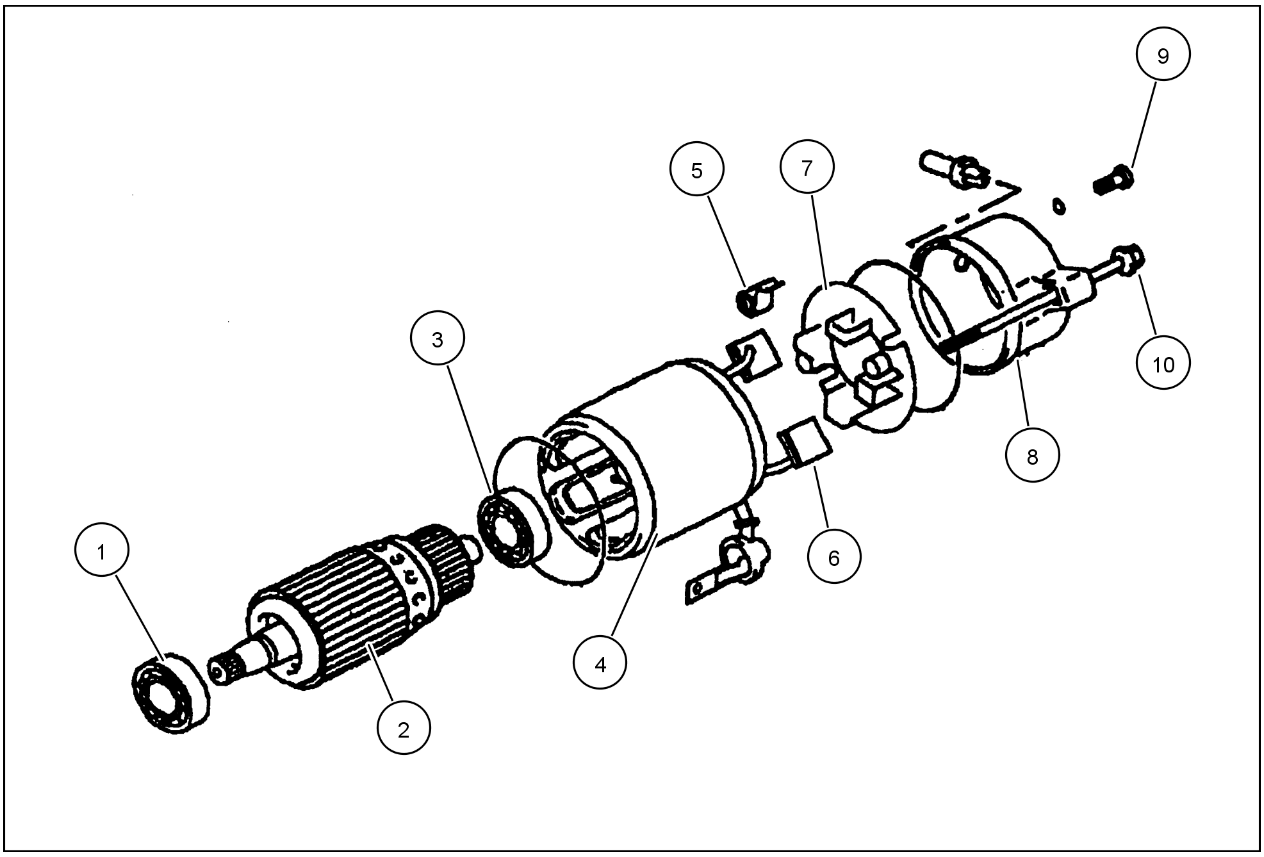


20002287 8

(1) Front Armature Bearing	**(5)** Brush Spring	**(9)** Screws
(2) Armature	**(6)** Brush	**(10)** Through Bolt
(3) Rear Armature Bearing	**(7)** Brush Holder	
(4) Motor/Field Coil Housing	**(8)** Brush Cover	

9. If removed, install the front and rear bearings, **(1)**, and **(3)**, to the armature, **(2)**.

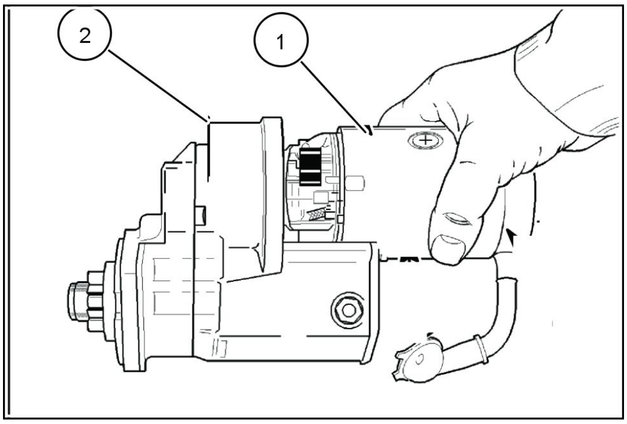
10. Install the armature, **(2)**, to the motor/field coil housing, **(4)**. Be sure that the rear bearing, **(3)**, is properly seated in the motor housing.

NOTE: *When installing the field coil brushes be sure that the aligning marks made on the brush holder and motor/field coil housing will line up when the brush holder is installed onto the armature commutator.*

11. Install the field coil brushes, **(6)**, into the brush holder, **(7)**, holding the brush springs, **(5)**, away as the brush is being inserted into the insulated brush holder.
12. Install the brush holder, **(7)**, onto the armature commutator.
13. Secure the brush cover, **(8)**, to the brush holder, **(7)** using the retaining screws, **(9)**.

NOTE: *Be sure the aligning marks made on the starter housing and motor/field coil housing line up when installing the motor assembly to the starter assembly.*

14. Install the motor assembly, **(1)**, into the starter assembly, **(2)**.



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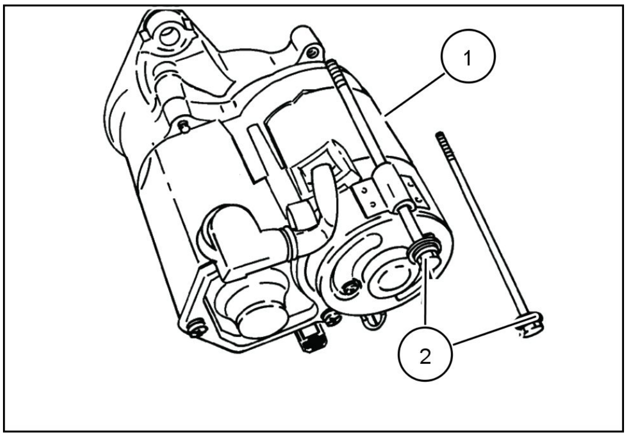
15. Secure the motor assembly, **(1)**, to the starter assembly using the long through bolts, **(2)**.



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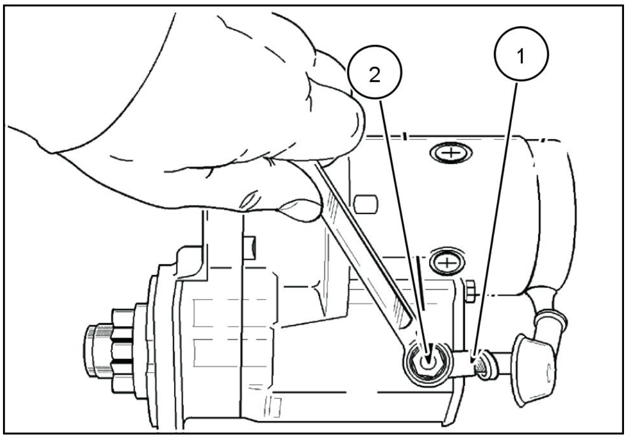
16. Install the field coil wire, **(1)**, the solenoid terminal, **(2)**.



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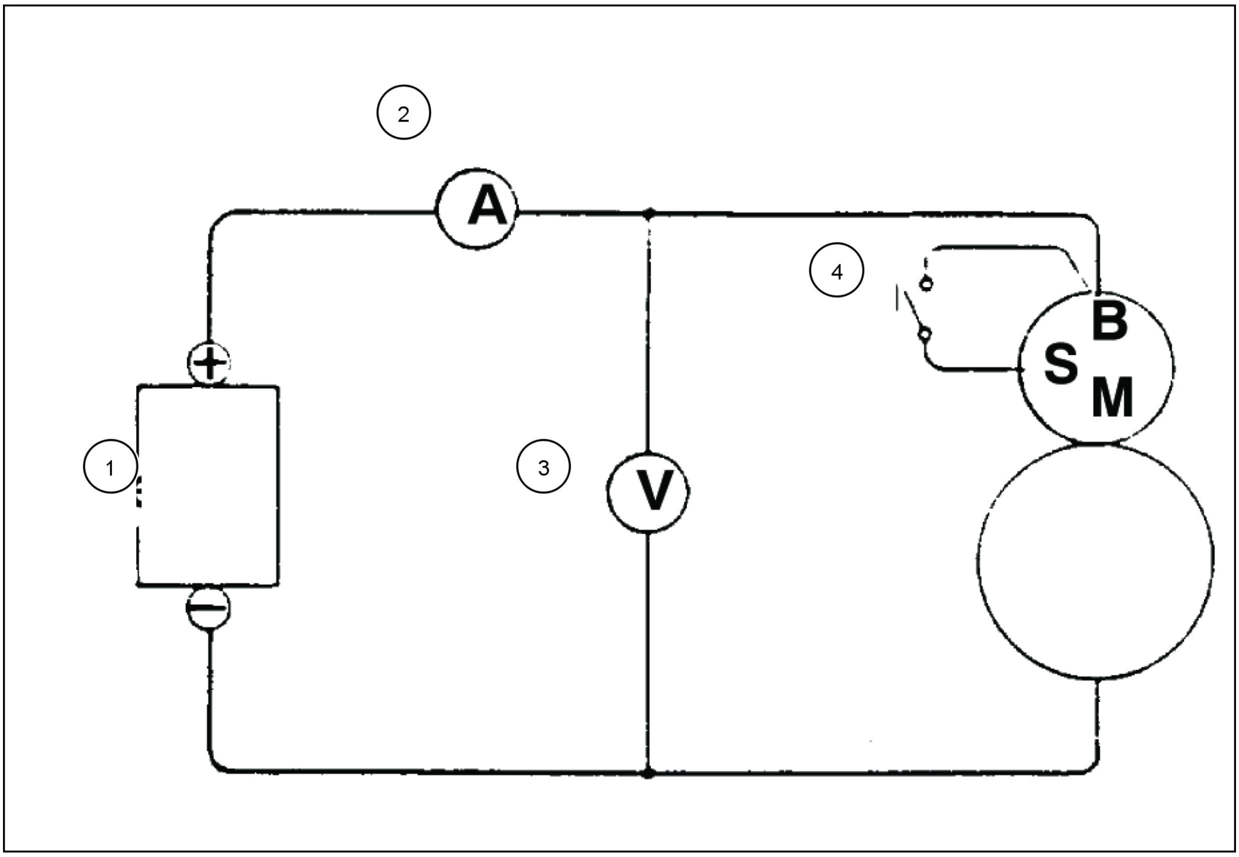
Next operation:
Engine starter - Electrical test No Load (B.80.A)

Engine starter - Electrical test No Load



(1) Battery, (2) Ammeter, (3) Voltmeter, (4) Switch

NOTE: *Before installing the starter motor to the tractor engine, it is recommended that a no load test be performed on the starter motor.*

NOTE: *Do not operate the starter for than 30 seconds at a time.*

Prior operation:
Engine starter - Assemble Starter motor (B.80.A)

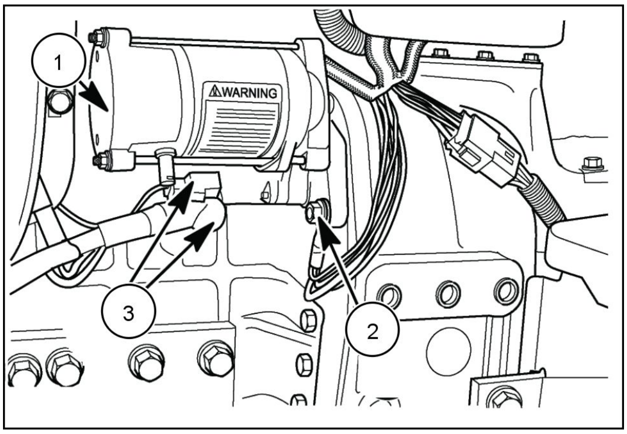
1. Connect a battery and switch to the battery terminal of the starter and the ’S’ terminal of the solenoid.
2. Connect an ammeter between the positive (+) battery terminal of the battery and the battery terminal of the starter solenoid.
3. Connect a voltmeter, after the ammeter, between the positive (+) lead from the battery and the negative (-) lead from the battery.
4. Close the switch and record the readings indicated on the ammeter and voltmeter.
5. Test starter components if any abnormal operation is noted.
6. Service limits are **11.5 V**, **110 A** maximum at **4000 RPM**.

Next operation:
Engine starter - Install Starter motor (B.80.A)

Engine starter - Install Starter motor

Prior operation:
Engine starter - Electrical test No Load (B.80.A)

1. Install the starter motor **(1)** to the engine and secure using the retaining bolts **(2)**. Be sure all ground terminals are connected to the bottom starter bolt.
2. Connect the tractor wiring harness connections to the starter **(3)**.
3. Connect the negative (-) battery cable to the battery.



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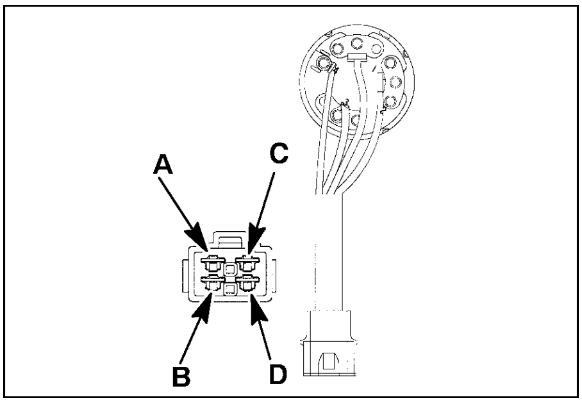
Engine starter - Test Key switch

Key Switch Terminals



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Terminal ID	Function	Wire Color
A	**12 V**Input	R
B	ACC Terminal	Gr / R
C	Heat	W
D	Start	R / Y

Testing

Position	Terminal Continuity
"OFF"	None
"ACC/RUN"	A and B
"HEAT"	A, B, and C
"START"	A, B, C, and D

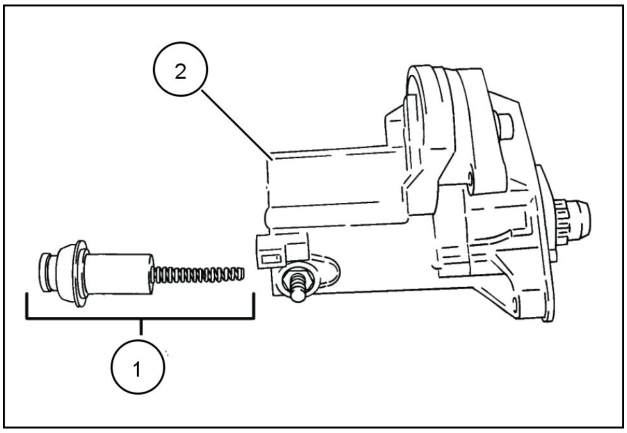
Starter solenoid - Electrical test

Prior operation:
Engine starter - Electrical test Starter motor (B.80.A)

NOTE: *The following test should be performed with the starter assembly partially assembled.*

NOTE: *If solenoid will not be disassembled after this test, apply white lithium grease to the armature drive gear, pinion clutch, idler gear and roller bearings, and the pinion clutch steel ball and return spring.*

1. Install the solenoid plunger and spring assembly, **(1)**, to the starter housing, **(2)**.



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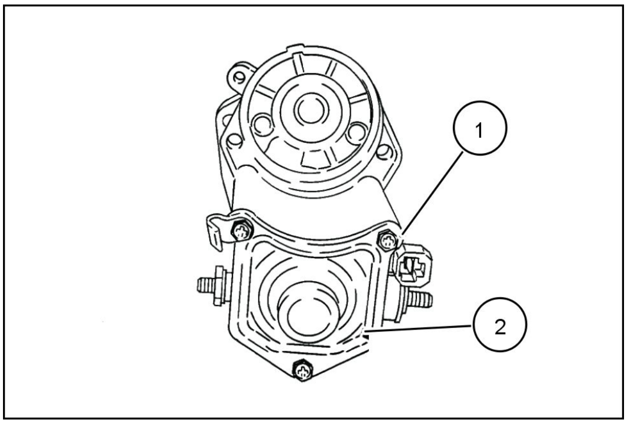
2. Install the solenoid cover and gasket to the starter housing. Install the screws, **(1)**, securing the solenoid cover, **(2)**, and gasket to the starter housing.



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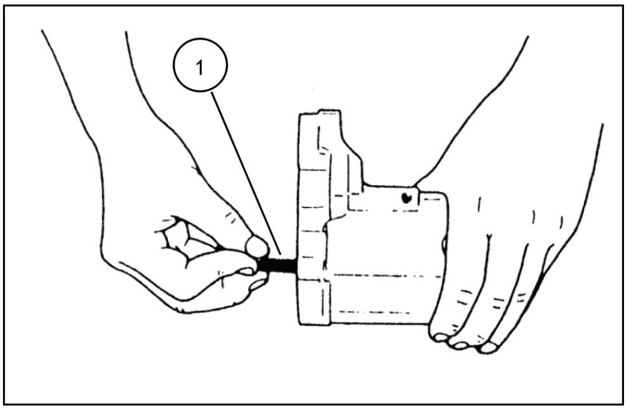
3. Install the return spring, **(1)**, into the solenoid.



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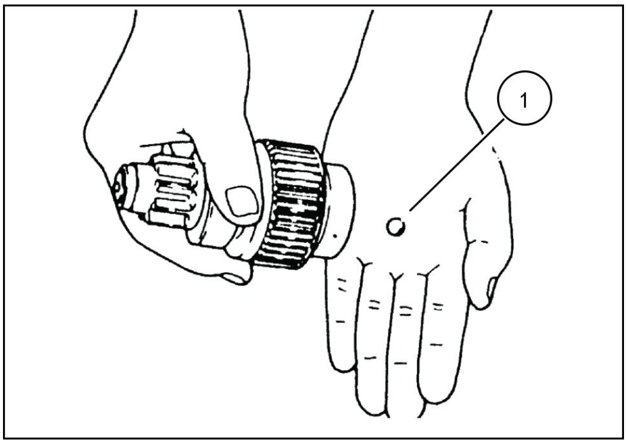
4. Install the steel ball, **(1)**, into the center of the pinion clutch.



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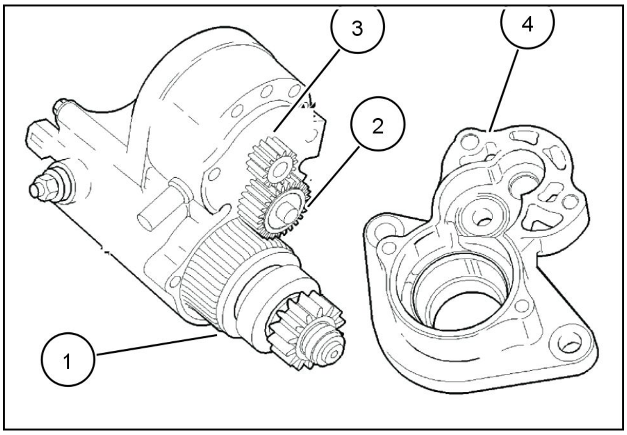
5. Install the pinion clutch, **(1)**, the starter housing. Make sure the rear clutch bearing is completely seated in the housing.
6. Grease the idler gear bearing with petroleum jelly and install the gear, **(2)**, and bearing onto the starter housing. Align the bearing and gear so that it meshes with the pinion clutch and is aligned with the hole in the housing for the pin which the bearing rides on.
7. Install the pinion gear, **(3)**, in the proper recess in the reduction unit cover, **(4)**, as the cover is being installed onto starter motor housing.



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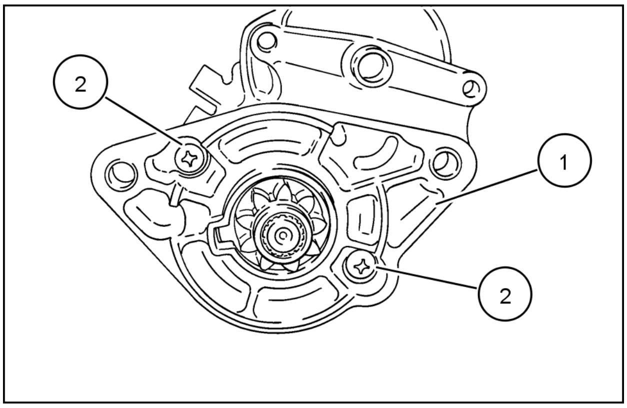
8. Secure the gear reduction cover, **(1)**, with the retaining screws, **(2)**.



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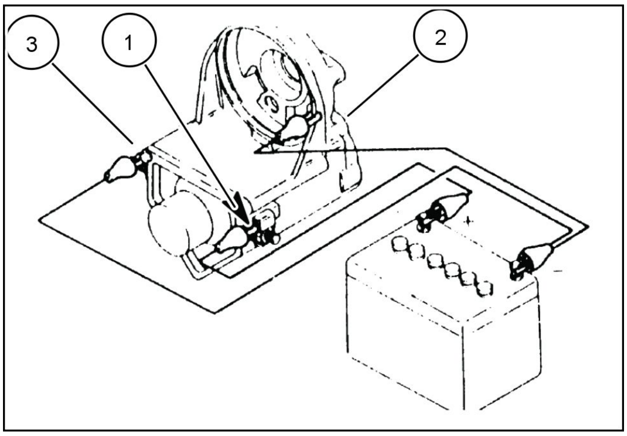
NOTE: *Do not perform this test for more than 3 - 5 seconds at a time, as damage may occur to the solenoid or other components.*

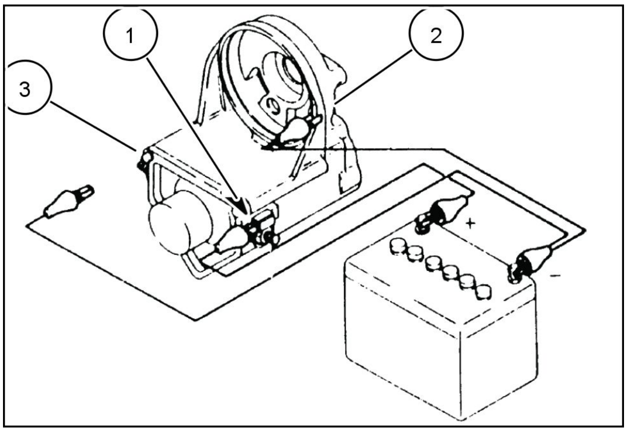
NOTE: *Be sure to use test leads that have 14 awg wire or thicker for this test.*

9. Connect a test lead from the positive (+) terminal of a **12 V** power source to the starter switch terminal, **(1)**, (spade terminal) of the starter.
10. Use another test lead to connect the negative (-) terminal of the **12 V** power source to the starter housing **(2)**.
11. Connect a second negative (-) test lead from the **12 V** power source to the field coil terminal, **(3)**. This completes the circuit to send current to the hold-in and pull-in coils of the solenoid.
12. Observe the starter pinion. The solenoid should have caused the pinion to jump forward when the third test lead was connected to the field coil terminal. This indicates the pull-in coil is working properly.



SEC55CH4PG42_2T 7

13. Remove the test lead to the field coil terminal, **(3)**, and observe the starter pinion. The solenoid should keep the pinion extended when the third test lead is removed. This indicates the hold-in coil is working properly.
14. If the solenoid fails to perform as described, replace the solenoid assembly.



SEC55CH4PG42_3 8

Next operation:
Engine starter - Assemble Starter motor (B.80.A)

Engine starter - Troubleshooting

Problem	Possible Cause	Correction
Pinion shaft fails to advance	Wiring: Open circuit battery, and switch terminal connections.	Repair or replace.
	Wiring: Open circuit, fuse.	Replace fuse.
	Key switch: No contact.	Repair or replace.
	Starter motor: Sleeve bearing burnt out.	Repair or replace.
	Starter motor: Lever broken.	Replace.
	Solenoid: Plunger movement defective or coil open or shorted.	Repair or replace.
Pinion motor rotates but no rotation transmitted to engine	Starting motor: Clutch defective.	Replace.
	Starting motor: Orbital gear or planetary gears damaged.	Replace.
Motor rotates before pinion meshes with ring gear	Starter motor: Shift lever damaged.	Replace.
	Starter motor: :Shift lever damaged	Replace.
	Starter motor: Slip ring defective.	Replace.
	Starter motor: Pinion teeth worn.	Replace.
	Starter motor: Pinion push out position defective.	Adjust.
	Engine: Ring gear worn.	Replace.
	Solenoid defective	Replace.
Pinion meshes with ring gear but starting motor fails to turn	Wiring: Line connecting solenoid to battery broken or defective ground.	Repair or replace.
	Wiring: Lead wire connecting solenoid to motor tightened improperly.	Repair or replace.
	Starting motor: Ball bearing locked.	Replace.
	Starting motor: Brush worn.	Replace.
	Starting motor: Improper installation.	Reinstall.
	Starting motor: Brush spring defective.	Replace.
	Starting motor: Commutator dirty.	Clean.
	Starting motor: Armature of field coil defective.	Repair or replace.
	Starting motor: Field coil-to-brush connection defective.	Replace.
	Solenoid: Contact not touching properly.	Replace.
	Solenoid: Contact contacting surface roughened.	Replace.
	Battery: In discharge state.	Recharge or replace.
Motor fails to stop after engine starts and key switch is turned off	Key switch: defective.	Replace.
	Defective solenoid.	Replace.

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SERVICE - Technical Publications & Tools

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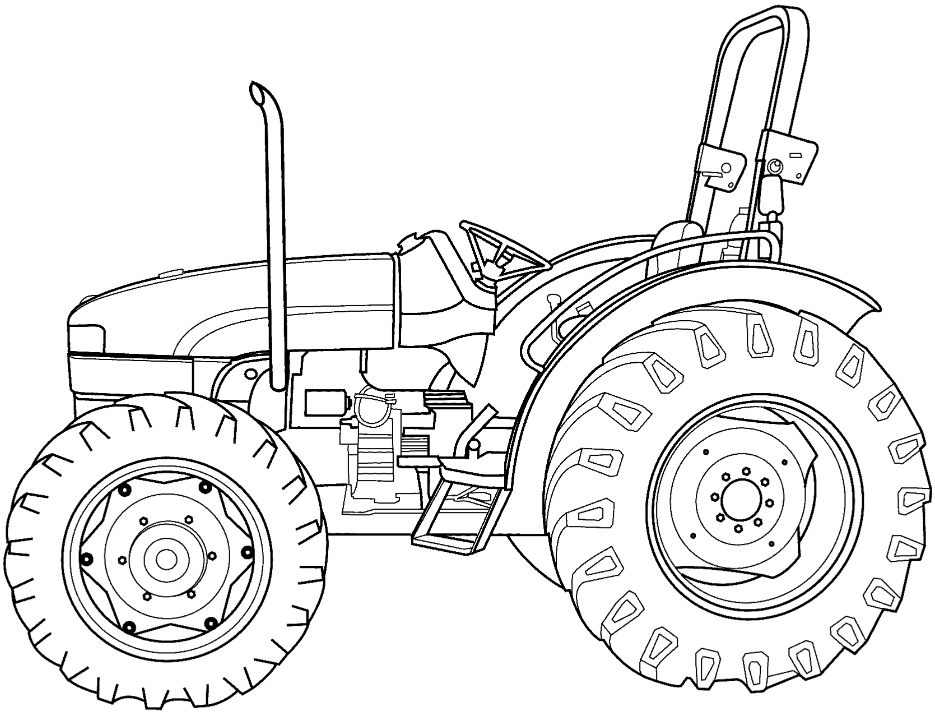
SERVICE MANUAL

TRANSMISSION, DRIVE AND PTO OUT



Workmaster 45
Workmaster 55

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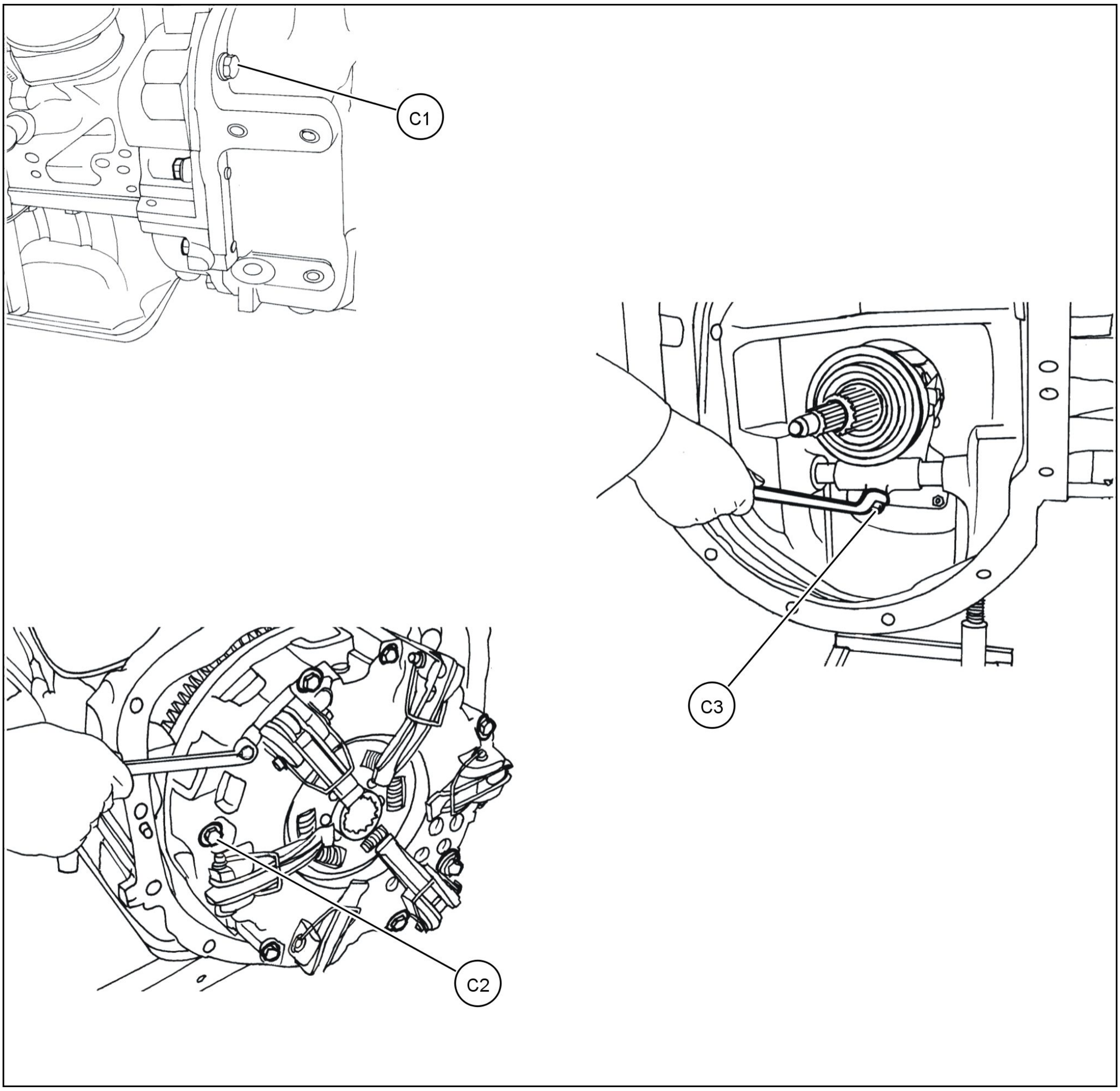
POWER COUPLING Clutch - General specification

Type Control Release mechanism	Independent, safety clutch Mechanical pedal for transmission Hand lever for PTO Dished spring Main clutch-Diaphragm spring PTO clutch-Coil spring
Plate material	Organic compound
Plate thickness:	
- transmission	**10.5 mm** (**0.41 in**) ± **0.3 mm** (**0.0118 in**)
- PTO	**7.6 mm** (**0.30 in**) ± **0.3 mm** (**0.0118 in**)
- wear limit	Refer to **POWER COUPLING Clutch - Inspect Clutch Assembly (C.10.C)**
Plate with pressure springs	Tangential springs
Transmission clutch control sleeve working clearance	**0.05 - 0.151 mm** (**0.002 - 0.006 in**)
PTO clutch control sleeve working clearance	**0.072 - 0.205 mm** (**0.003 - 0.0081 in**)
PTO clutch lever free play adjustment	**2.5 - 5 mm** (**0.098 - 0.197 in**)
Transmission clutch pedal free play adjustment	**45 - 50 mm** (**1.77 - 1.97 in**)
Transmission pedal requirements	
Pedal pin diameter	**27.948 - 28.0 mm** (**1.100 - 1.102 in**)
Supporting bush internal diameter (fitted, non-dressed)	**28.020 - 28.072 mm** (**1.1031 - 1.1052 in**)
Pin/bush play	**0.02 - 0.124 mm** (**0.00079 - 0.0049 in**)
Pedal bracket internal diameter	**32.927 - 32.966 mm** (**1.296 - 1.298 in**)
Bush outer diameter	**33.009 - 33.030 mm** (**1.2996 - 1.3004 in**)
Pedal bracket/bush interference fit	**0.043 - 0.103 mm** (**0.0017 - 0.0041 in**)

POWER COUPLING Clutch - Torque

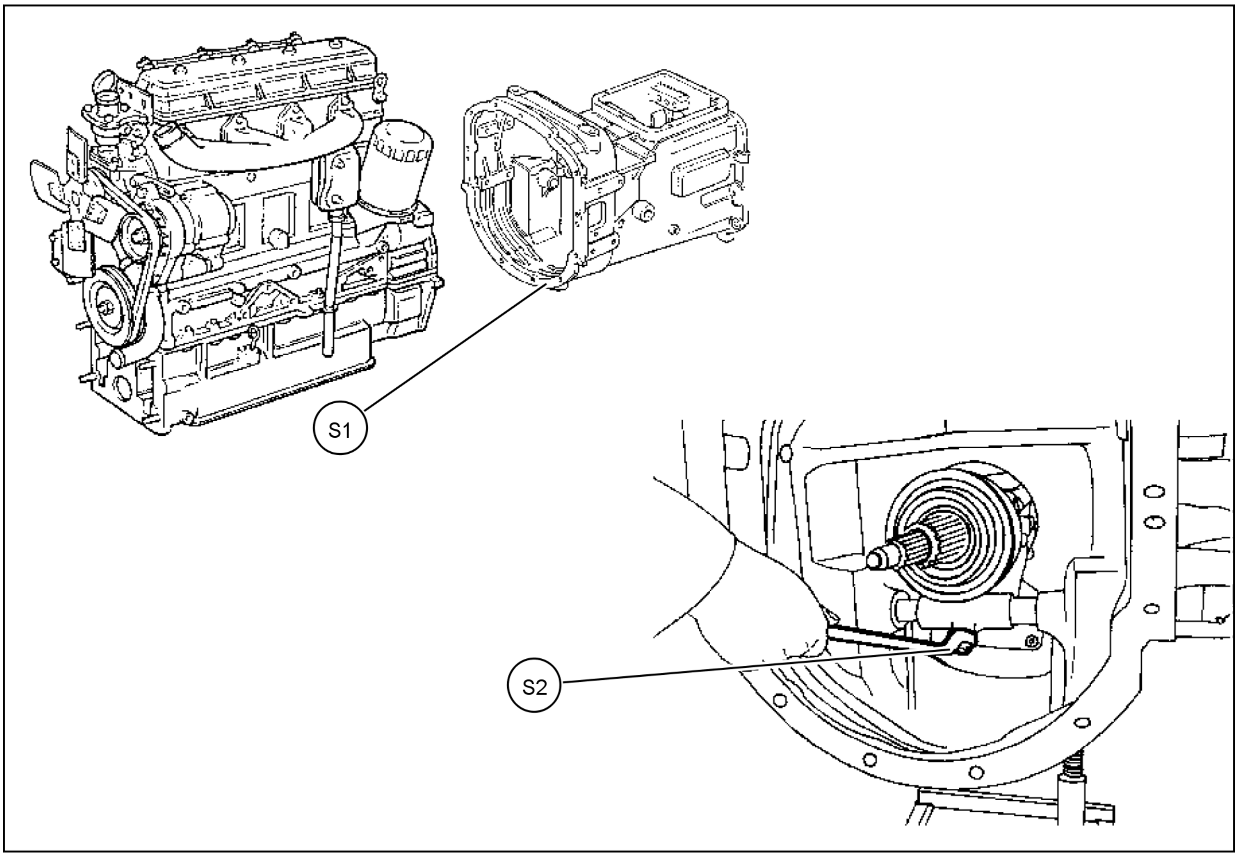
Description	Thread Size (mm)	Torque N·m (lb ft)
Transmission housing to flywheel housing buckle up bolts **(C1)**	M12 X 1.25 X 35	**100 N·m** (**74 lb ft**)
Clutch assembly mounting bolts **(C2)**	M8 X 1.25 X 40	**26 N·m** (**19 lb ft**)
Bolts, Release Fork **(C3)**	M16 X 1.5 X 30	**68 N·m** (**50 lb ft**)



20097611 1

POWER COUPLING Clutch - Sealing

Operation Description	Sealant Specification
Engine to front reduction gearbox buckle up **(S1)**	**LOCTITE® 242**
Bolts, release fork **(S2)**	**LOCTITE® 242**



20097530 1

POWER COUPLING Clutch - Dynamic description

The clutch system is double clutch mechanical type. It includes two dry clutch discs with non-asbestos, organic material pads. One clutch disc is to connect transmission to engine and another for connecting PTO directly to engine, independent of transmission.

The clutch is located in front of the transmission. The transmission (main) clutch is operated by means of foot pedal and PTO clutch is operated by hand lever located on right side below rear hood panel. The clutch system is composed of the clutch housing, clutch pressure plate, disc ring, clutch release fingers, clutch release bearings and clutch discs.

OPERATION

When both the clutches are engaged, the PTO clutch pressure plate pushes the PTO clutch disc against engine flywheel and transmission pressure plate pushes the clutch housing by the spring action of dish ring.

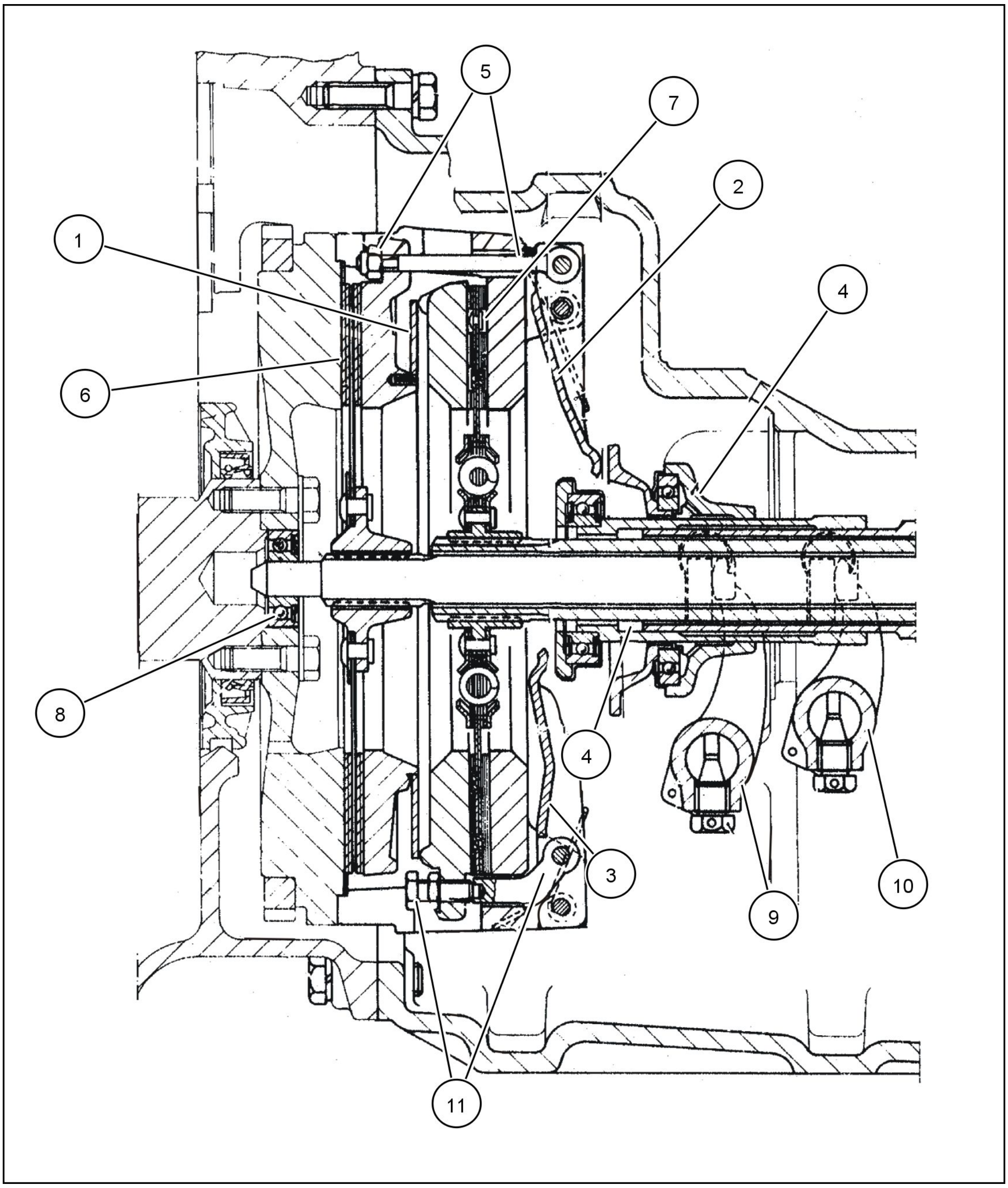
The friction between the clutch disc, flywheel and clutch housing transmits the engine power to the transmission drive shaft and PTO drive shaft independently.

The clutch pedal is connected to the main clutch release bearing by means of mechanical linkage components.

When the clutch pedal is pressed, the clutch release bearing moves forward and discharges the main clutch fingers. Consequently, the clutch pressure plate backs off and releases the clutch disc from the clutch housing. The transfer of engine power to the transmission is stopped.

When the clutch pedal is released, the main clutch release bearing disengages the main clutch finger which acts on the clutch pressure plate and causes the clutch housing, main clutch discs and pressure plates to come in contact. The flow of power from the engine and transmission is re-established. Similarly PTO clutch is engaged and disengaged independent of transmission clutch by operating PTO clutch control lever.

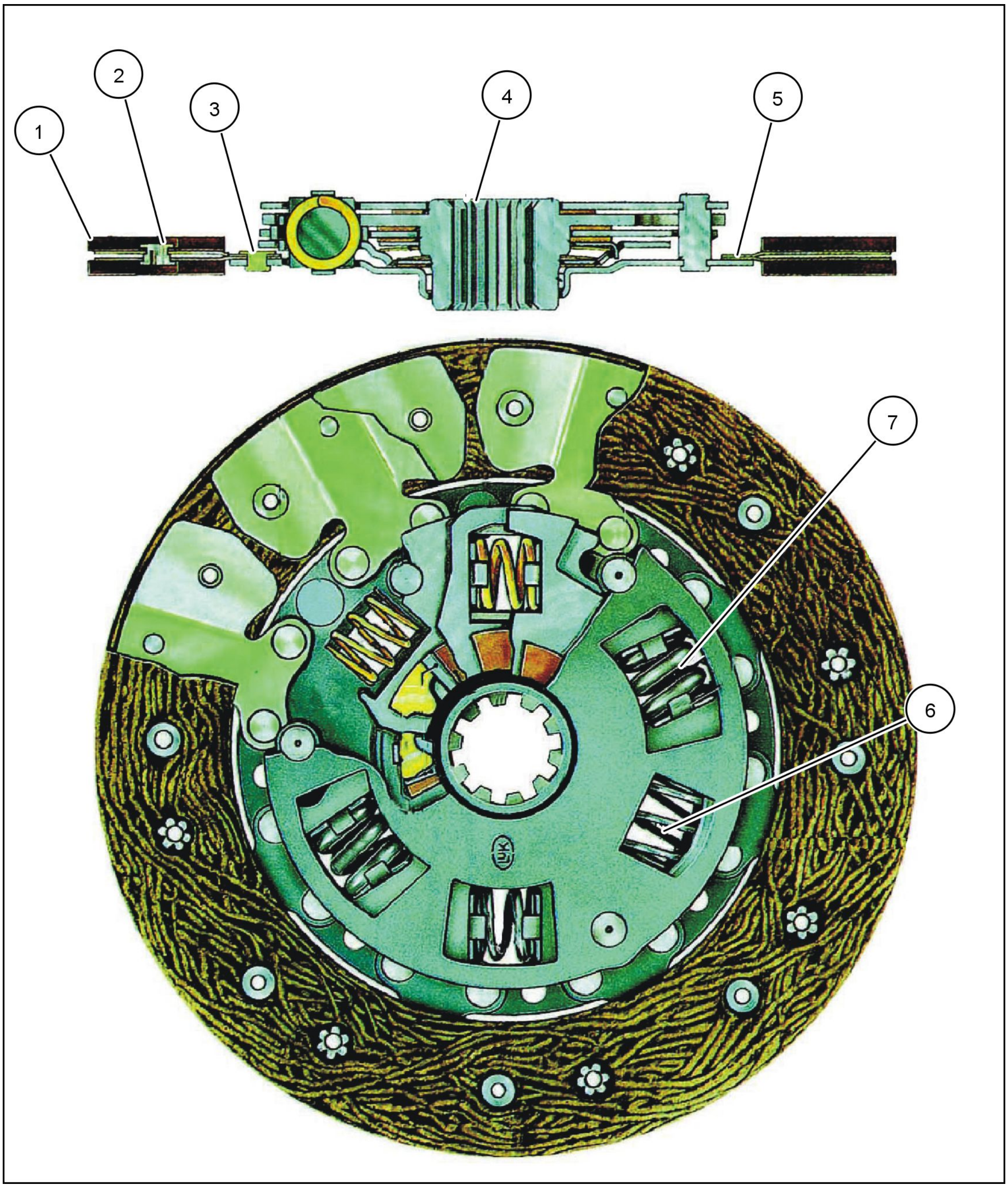
POWER COUPLING Clutch - Sectional view Clutch Assembly



20097531 1

1. Dish Spring
2. PTO clutch release fingers
3. Transmission clutch release fingers
4. Release control sleeves with thrust bearings
5. PTO clutch release lever locknuts & adj. link
6. PTO clutch plate
7. Transmission clutch plate
8. Pilot bearing
9. PTO clutch release fork
10. Transmission clutch release fork
11. Transmission clutch release lever locknut, adjusting screw and lever

POWER COUPLING Clutch - Sectional view Clutch plate



20097591 1

1. Clutch facing
2. Facing rivet
3. Segment rivet
4. Hub
5. Segment
6. Idle damper spring
7. Main damper spring

POWER COUPLING Clutch - Remove Clutch Assembly

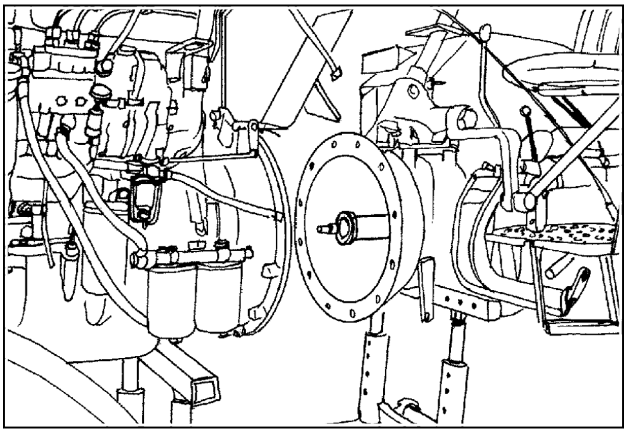
⚠ **WARNING** ⚠

Handle all parts carefully. Do not put your hands or fingers between parts. Always wear suitable safety items such as fitted clothing, safety goggles, gloves, shoes, etc. Failure to comply could result in death or serious injury.

M954A

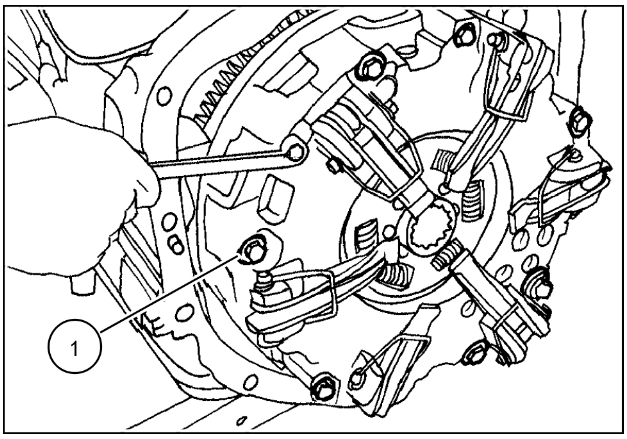
NOTE: *It is necessary to split the tractor between Engine and Transmission housing to gain access to the clutch.*

1. Separate the Transmission housing from Engine as described in **ENGINE - Remove (B.10.A)**.



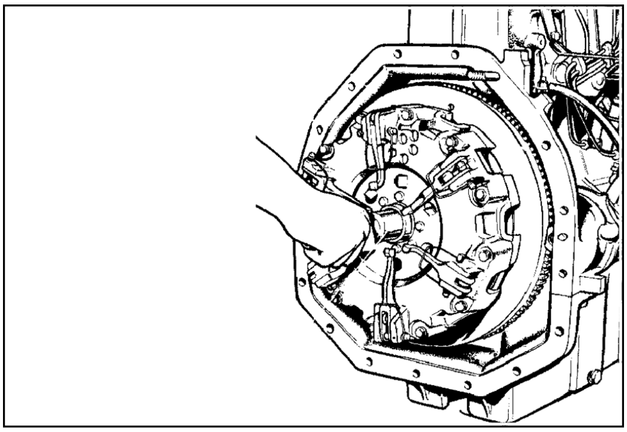
20097512 1

2. Remove the four of the six capscrews, **(1)**, that retain the clutch assembly to the engine fly wheel.



20097525 2

3. Insert the double clutch aligning arbor # **380002740** into the clutch disc splines. Remove the two remaining capscrews that retain the clutch assembly to the flywheel. Then remove the clutch assembly with the PTO clutch disc from the flywheel.



20097526 3

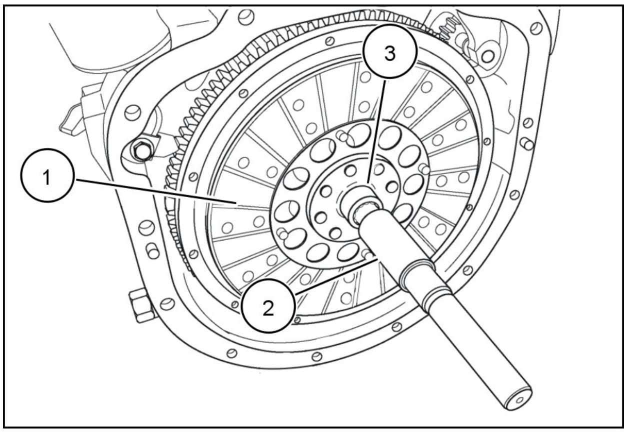
Next operation:
POWER COUPLING Clutch - Disassemble Clutch Assembly (C.10.C)

POWER COUPLING Clutch - Install Clutch Assembly

Prior operation:
POWER COUPLING Clutch - Assemble Clutch Assembly (C.10.C)

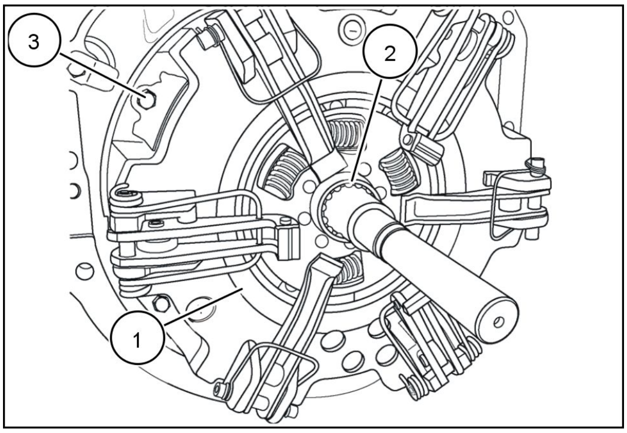
1. Install the PTO clutch disc, **(1)**, onto clutch aligning arbor tool, **380002740 (2)**, and insert assembly into pilot bearing in the flywheel.

NOTE: *When installing the clutch disc, make sure the flange,* ***(3)****, on disc is facing away from the flywheel.*



20097527 1

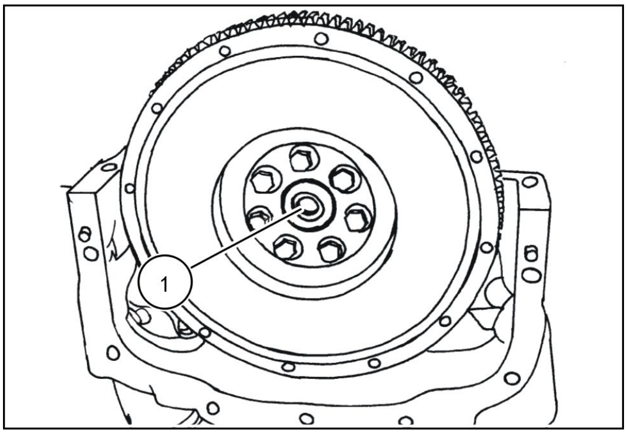
2. Install the clutch assembly, **(1)**, over the special tool, **(2)**, still in the flywheel.
3. Install the M8 x 1.25 x 45 mm bolts with lock washers, **(3)** and tighten in a star pattern to avoid damaging components. Torque the hardware to **26 N·m** (**19 lb ft**)
4. Install the transmission to the engine as described in **ENGINE - Install (B.10.A)**.



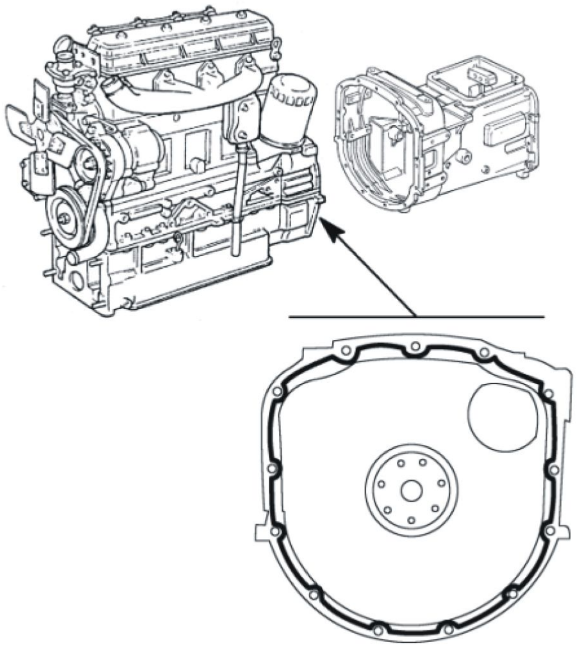
20097533 2

Install the clutch assembly back on flywheel taking care of the following:

5. Check condition of pilot bearing, **(1)**, pressed in flywheel. Replace in the event of excessive noise or binding.
6. Install old/new bearing packing the seat with grease.
    - Before securing the transmission housing and engine, thoroughly clean and degrease mating surfaces and apply a bead of silicone sealer of approximately. **2 mm** (**0.08 in**) of diameter following pattern shown in Figure **4**.



20097534 3



20097535 4

Next operation:
Command - Adjust Release lever height adjustment (C.10.C)

POWER COUPLING Clutch - Disassemble Clutch Assembly

Prior operation:
POWER COUPLING Clutch - Remove Clutch Assembly (C.10.C)

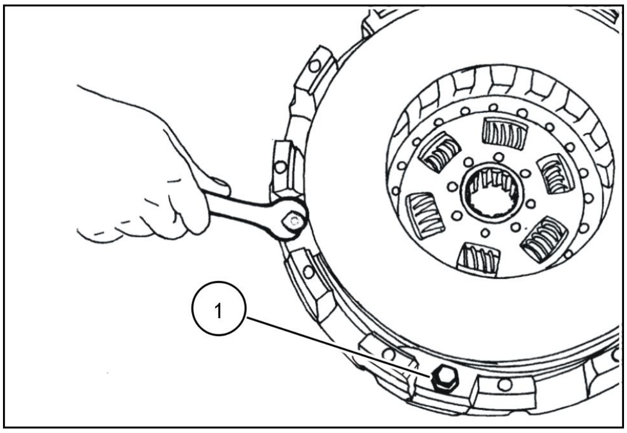
⚠ WARNING ⚠

Handle all parts carefully. Do not put your hands or fingers between parts. Always wear suitable safety items such as fitted clothing, safety goggles, gloves, shoes, etc. Failure to comply could result in death or serious injury.

M954A

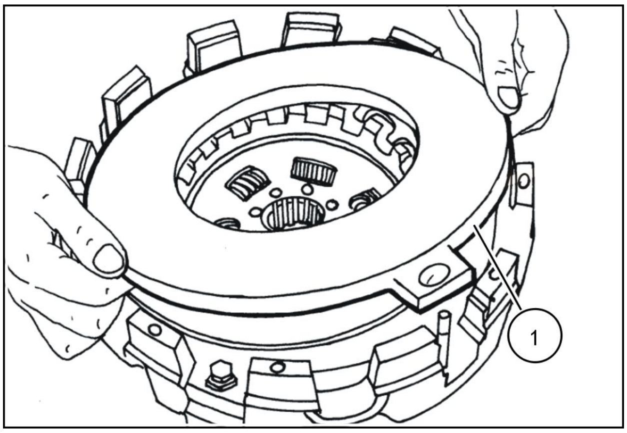
1. Loosen the PTO clutch release lever locknuts, **(1)**.

NOTE: *Since the locknuts are under the load of disk ring, loosen all these gradually and evenly by rotating 1/4 to 1/2 turns.*



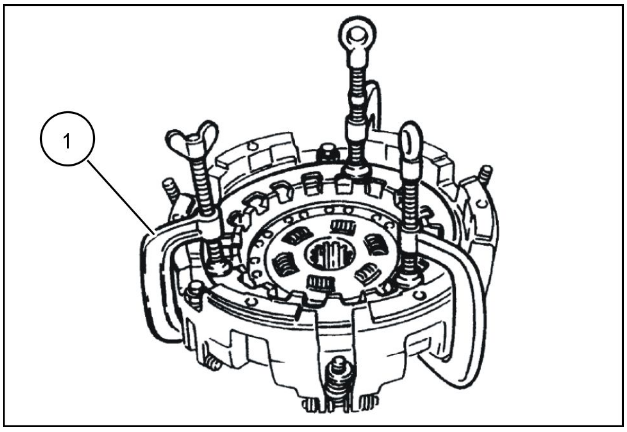
20097536 1

2. Remove PTO pressure plate, **(1)**.



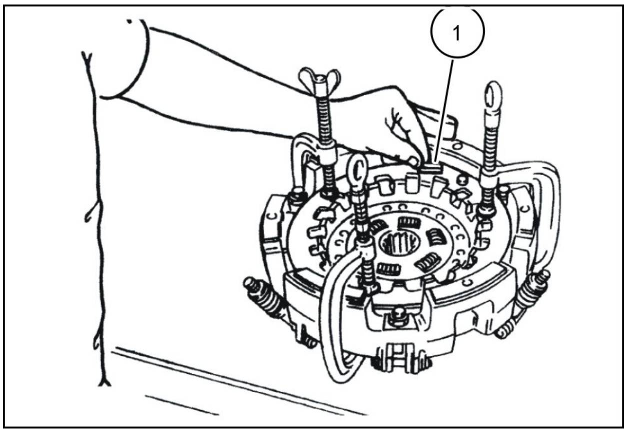
20097537 2

3. Position the clamps, **(1)**, at intervals of **120 °** on the clutch body and gradually and carefully squeeze the Belleville spring disk.



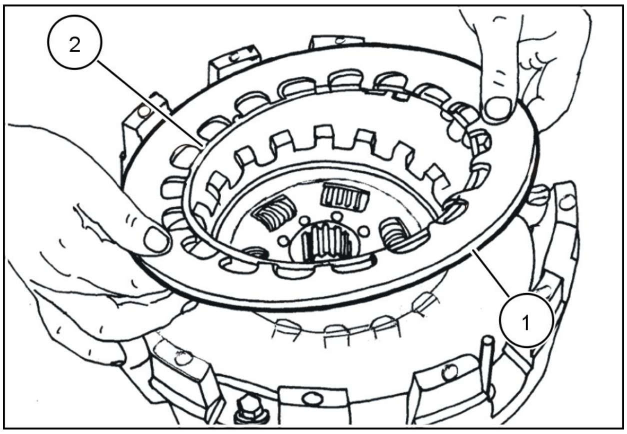
20097538 3

4. Extract the spring retaining pins, **(1)**, from the seats.



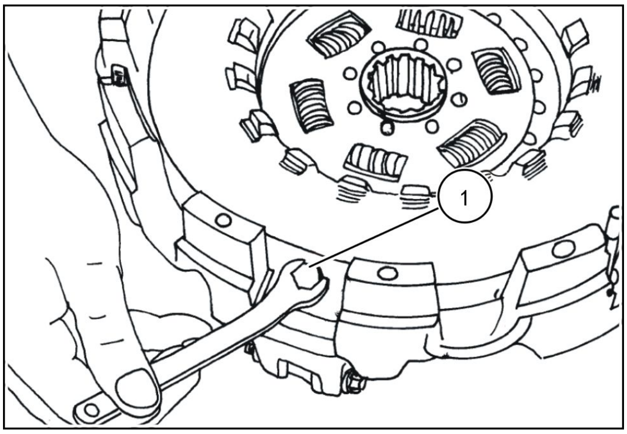
20097539 4

5. Remove disk ring, **(1)**, and lock ring, **(2)**.



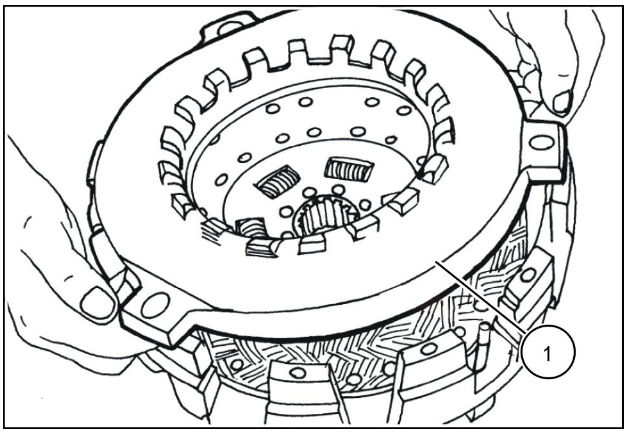
20097540 5

6. Loosen lock nut, **(1)**.



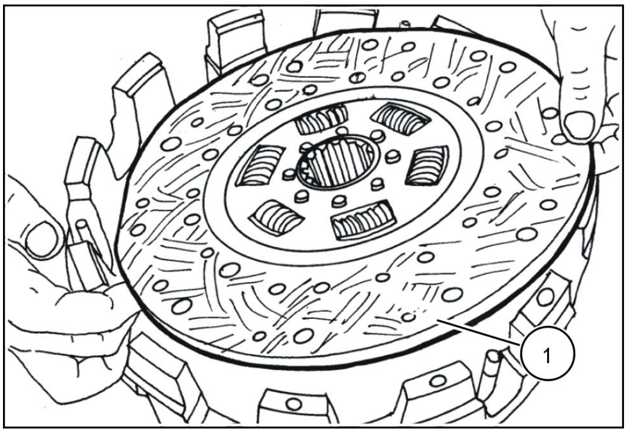
20097553 6

7. Remove transmission clutch pressure plate, **(1)**,



20097541 7

8. Remove transmission clutch disc, **(1)**, from the housing.

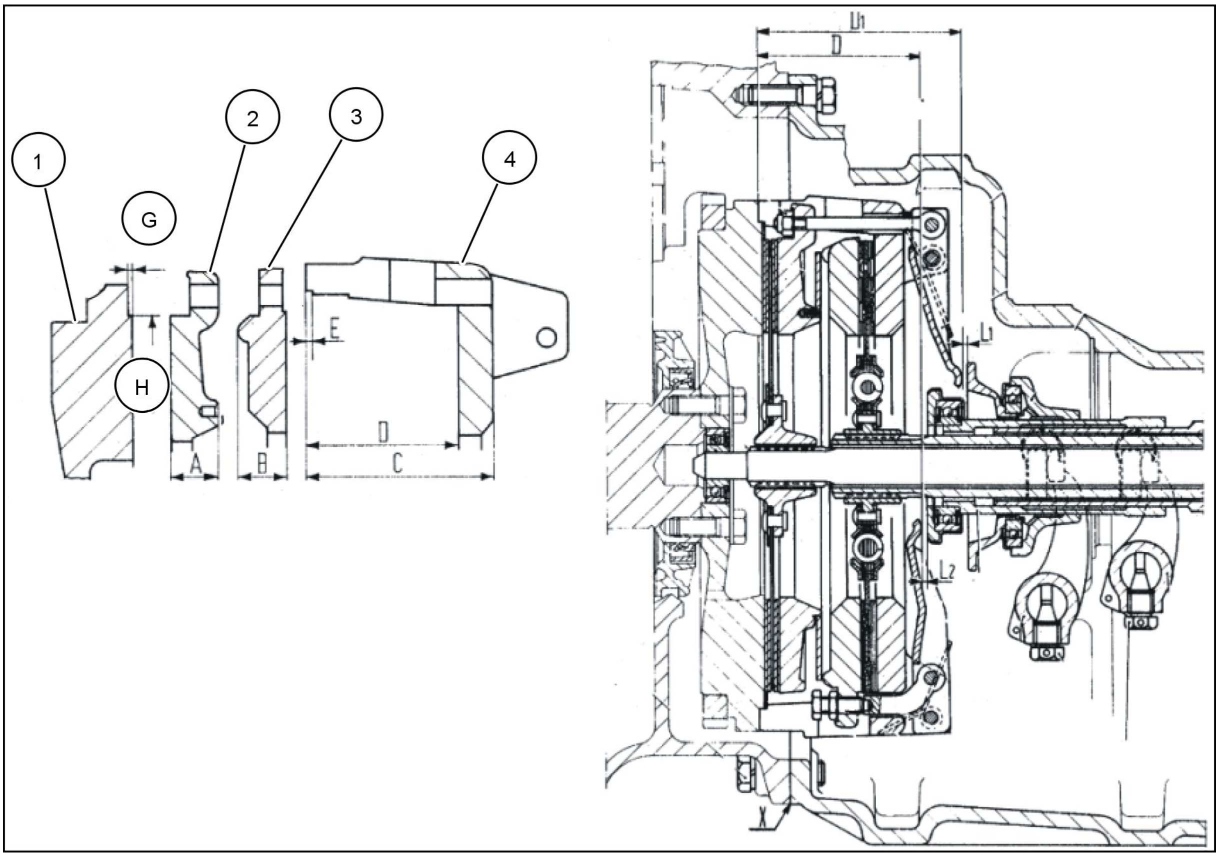


20097542 8

Next operation:
Command - Disassemble Release Fingers (C.10.C)

POWER COUPLING Clutch - Inspect Clutch Assembly

Prior operation:
POWER COUPLING Clutch - Disassemble Clutch Assembly (C.10.C)



20097548 1

H - Ø 300 mm (11.8 in)
G - 2 mm (0.1 in)

1. Check clutch driven discs for wear and replace if rivets are near or flush with top facing.
2. Discs are also to be replaced if the organic facings are found to be soaked with oil.
3. Check condition of clutch housing and pressure plate friction surfaces. If necessary dress, noting that dimensions of pressure plates and clutch housing must not be reduced below the limits described below, otherwise replace as necessary.
   - Fly wheel, **(1)**, under cut - ’A’ = **2 mm** (**0.0787 in**).
   - PTO clutch pressure plate, **(2)**, thickness - ’B’ = **22 mm** (**0.866 in**).
   - Transmission clutch pressure plate, **(3)**, thickness - ’C’ = **24 mm** (**0.945 in**).
   - Clutch housing, **(4)**, under cut - ’E’ = **2.5 mm** (**0.0984 in**).
   - Dressing allowance - ’F’ = **70 mm** (**2.8 in**) ± **0.15 mm** (**0.00591 in**)
   - Calculate Dimension ’F’ as follows

     F=A+B+C+S1+S2+P
     Where

     S1 = PTO clutch disc thickness
     S2 = Transmission clutch disc thickness
     P = Spring dimensions to restore original load = **4.5 mm** (**0.177 in**) (fixed).
   - Check that value ’F’ is equal to **70 mm** (**3 in**) ± **0.15 mm** (**0.00591 in**)
   - In restoring value ’F’ check that clutch housing thickness ’E’ does not fall below **17 mm** (**0.669 in**). i.e., D-F = E > **17 mm** (**0.669 in**).
   - Check that the undercut ’E’ on clutch housing is deeper than **2.5 mm** (**0.0984 in**) and restore as necessary.
   - If necessary dress friction face on flywheel and restore external undercut ’A’ of **2 mm** (**0.0787 in**).

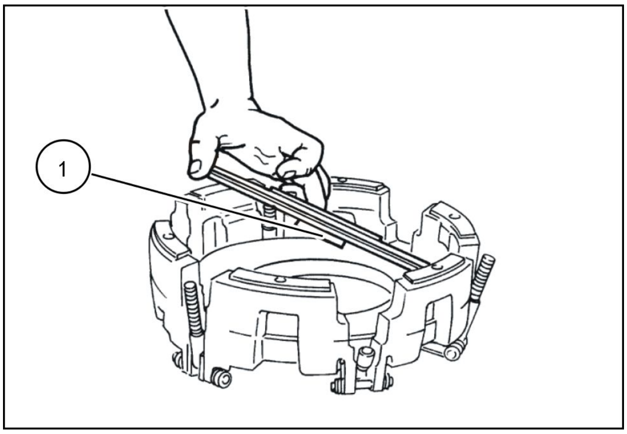
Next operation:
POWER COUPLING Clutch - Assemble Clutch Assembly (C.10.C)

POWER COUPLING Clutch - Assemble Clutch Assembly

Prior operation:
Command - Assemble Release Fingers (C.10.C)

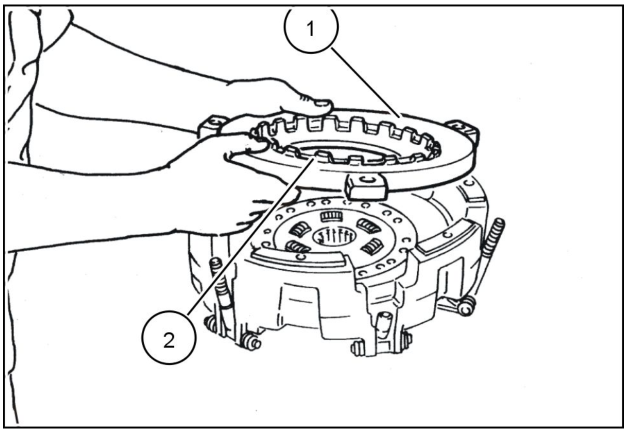
1. Install the main clutch disk, **(1)**, into the housing.

NOTE: *Install clutch disc with flange facing towards the release fingers.*



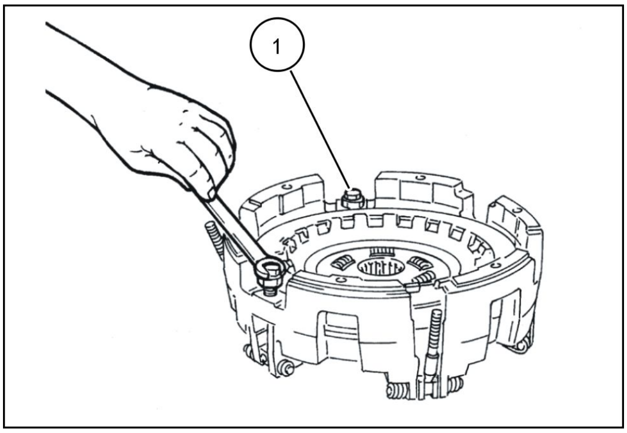
20097549 1

2. Install the inner clutch pressure plate, **(1)**, with contact surface facing the main clutch disc.
3. Install the large ring, **(2)**, as shown. The ring will start and stop at pin in plate.



20097550 2

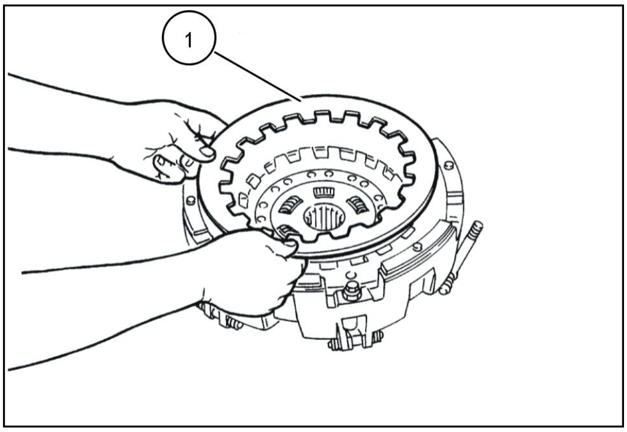
4. Install the set screw and lock nut assembly, **(1)**, into the pressure plate for the release fingers.



20097551 3

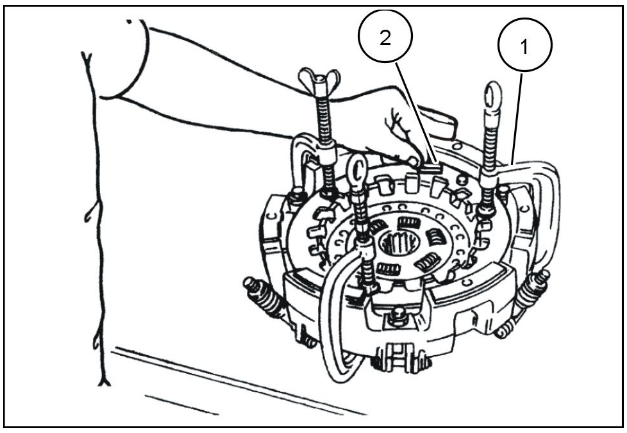
5. Install the large spring plate, **(1)**, onto pressure plate.

NOTE: *The slots in spring plate must engage the locating pin in pressure plate.*



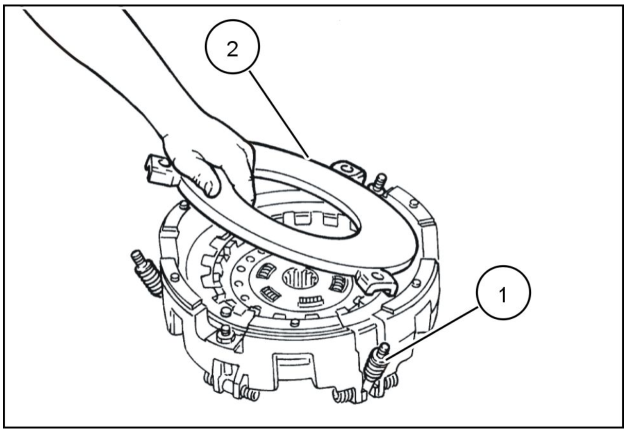
20097552 4

6. Install the large C-Clamps, **(1)**, around the spring plate in **120 °** increments.
7. Install the retaining plate, **(2)**, around the spring plate as shown.The plate will engage into a slot in the housing assembly.
8. Remove the C-Clamps, **(1)**, after all retaining plates are installed in the clutch housing.



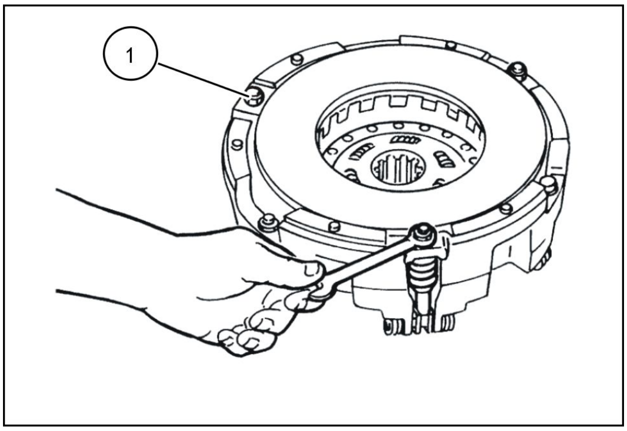
20097539 5

9. Install the springs, **(1)**, around each release lever.
10. Install the pressure plate, **(2)**, with clutch disc face towards the flywheel.



20097554 6

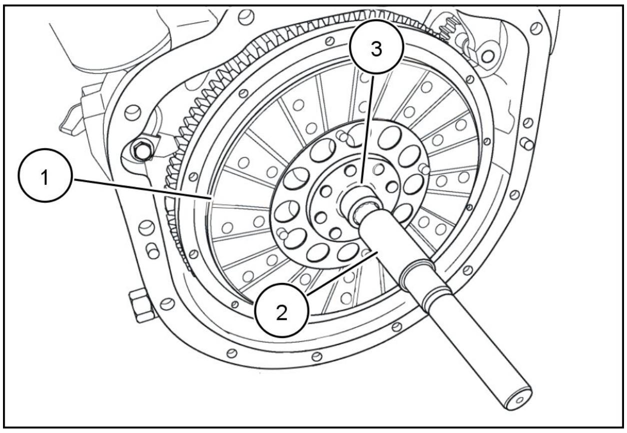
11. Secure the pressure plate to the release fingers with lock nuts, **(1)**.



20097555 7

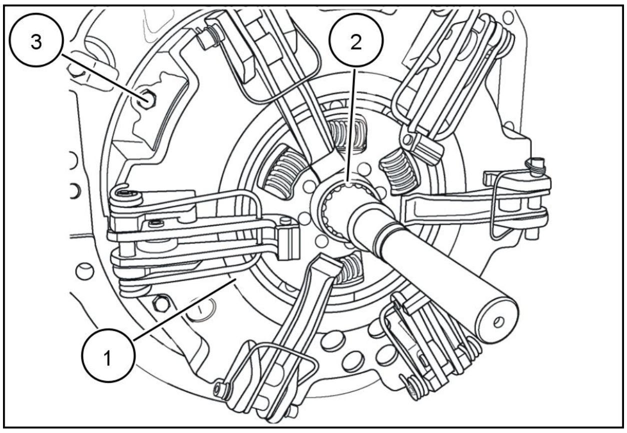
12. Install the PTO clutch disc, **(1)**, onto clutch aligning arbor tool, **380002740 (2)**, and insert assembly into bearing in flywheel.

NOTE: *When installing the clutch disc, make sure the flange,* ***(3)****, on disc is facing away from the flywheel.*



20097527 8

13. Install the clutch assembly, **(1)**, over the special tool, **(2)**, still in the flywheel.
14. Install the M8 x 1.25 x 45 mm bolts with lock washers, **(3)** and tighten in a star pattern to avoid breaking components. Torque the hardware to **26 N·m** (**19 lb ft**).
15. Perform clutch release finger adjustments as described in **Command - Adjust (C.10.C)**.
16. Install the transmission to the engine as described in **ENGINE - Install (B.10.A)**.



20097533 9

Next operation:
POWER COUPLING Clutch - Install Clutch Assembly (C.10.C)

POWER COUPLING Clutch - Replace Clutch Assembly

Important Points to be Taken Into Account While Replacing Clutch

⚠ **WARNING** ⚠

Handle all parts carefully. Do not put your hands or fingers between parts. Always wear suitable safety items such as fitted clothing, safety goggles, gloves, shoes, etc. Failure to comply could result in death or serious injury.

M954A

1. Check the condition of pilot bearing, replace if necessary.
2. Check the condition of the oil seals on the engine and transmission sides for leaks and replace if necessary.
3. Check the flywheel face is free from scores and cracks. When machining the surface, follow specified tolerances.

NOTE: *Machine the bolting surface to the same amount of the running surface, to maintain original clamp loads.*

⚠ **WARNING** ⚠

Always use suitable tools to align holes. DO NOT USE HAND OR FINGERS. Failure to comply could result in death or serious injury.

B020A

4. Ensure correct alignment of the clutch cover to the flywheel. Use Special Tool # **380002740** for alignment.
5. Ensure the clutch cover is secured to the flywheel evenly and sequentially. Use new spring washers.
6. After an initial running-in period, any variation lever height will correct itself.
7. Before fitting, check the clutch plate for lateral runout.
8. Ensure the clutch plate is fitted the correct way. Observe the direction as indicated on the driven plate.
9. Check the gearbox input shaft for damage. Only nonmetallic based high melting point grease should be used to lubricate the splines and release bearing guide sleeve.
10. Check the release bearing guide sleeve for wear and replace if necessary.
11. After applying the grease to the gearbox input shaft, guide the clutch driven plate on to the shaft and remove the surplus grease.
12. Ensure correct alignment between the engine and transmission/clutch housing, ensure that the locating dowels are fitted and are secure.
13. Carefully guide the input shaft into the clutch hub splines, taking care not to allow the weight of the transmission to hang on the hub of the driven plate, this will prevent irreparable damage to the segments and associated cushion springs.

14. Ensure the correct adjustment of clutch pedal free play.

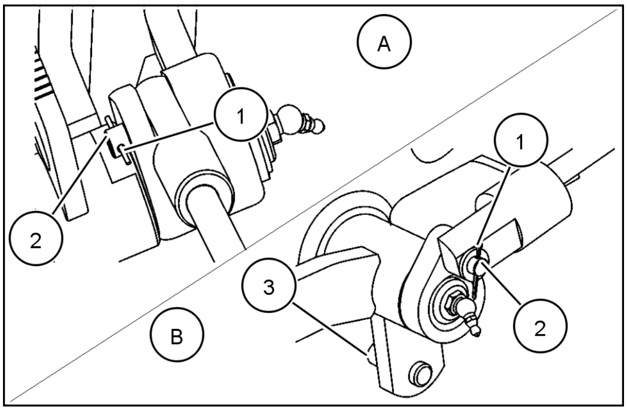
Command - Remove Clutch pedal

⚠ **WARNING** ⚠

Handle all parts carefully. Do not put your hands or fingers between parts. Always wear suitable safety items such as fitted clothing, safety goggles, gloves, shoes, etc. Failure to comply could result in death or serious injury.

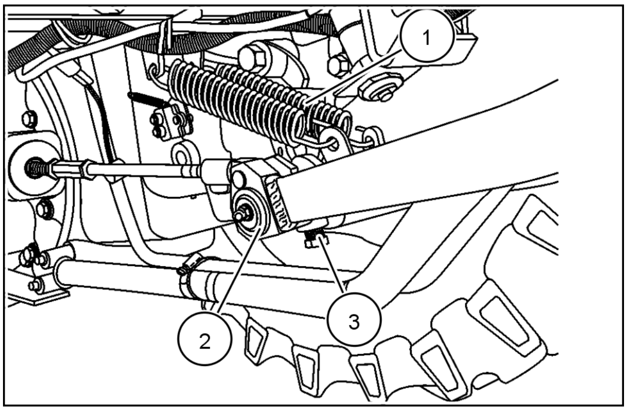
M954A

1. Remove the cotter pin, **(1)**, and remove the roll pin, **(2)**, on the right-hand side brake linkage, **(A)** and on the left-hand side brake linkage, **(B)** and remove the brake linkage rods from the pedals.
2. Remove the cotter pin and washer and remove the clutch linkage from the clutch pedal, **(3)**.



20099884 1

3. Remove the brake pedal springs, **(1)**, and clutch pedal spring.
4. Remove the circlip, **(2)** and remove the shaft locking conical screw, **(3)**.

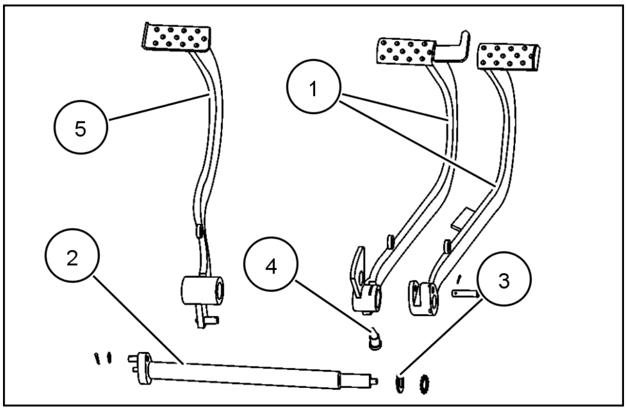


20098833 2

5. Slide out both the left-hand and right-hand side brake pedals, **(1)**, from the clutch/brake pedal support shaft, **(2)**.

NOTE: *Remove the washer, **(3)** and conical screw, **(4)**.*

6. Remove the pedal support shaft, **(2)** and remove the clutch pedal, **(5)**, from the left-hand side of the tractor.



20098834 3

Next operation:
Command - Inspect Clutch pedal (C.10.C)

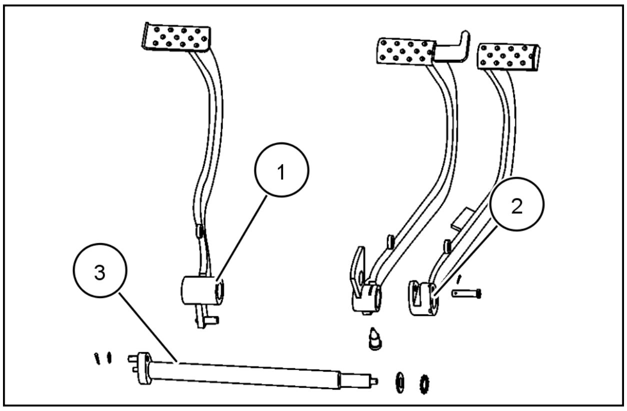
Command - Inspect Clutch pedal

Prior operation:
Command - Remove Clutch pedal (C.10.C)

1. Inspect the shaft bushings for wear and/or damage.
2. Replace the bushings using suitable bushing remover/installer tool.

NOTE: *The shaft bushings are located in the clutch pedal,* ***(1)*** *and outer brake pedal,* ***(2)****.*

3. Inspect shaft, **(3)**, for wear and/or damage. Replace the shaft as needed.



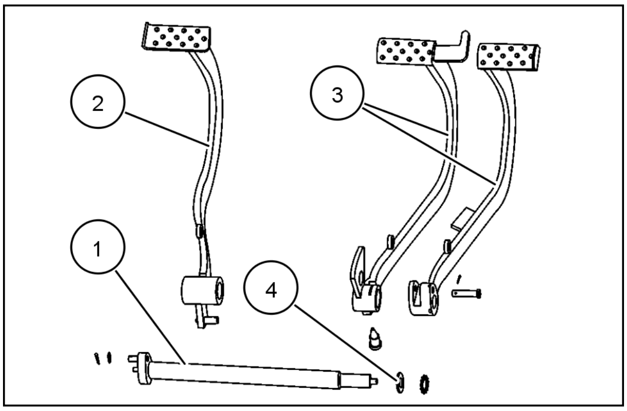
20098834 1

Next operation:
Command - Install Clutch pedal (C.10.C)

Command - Install Clutch pedal

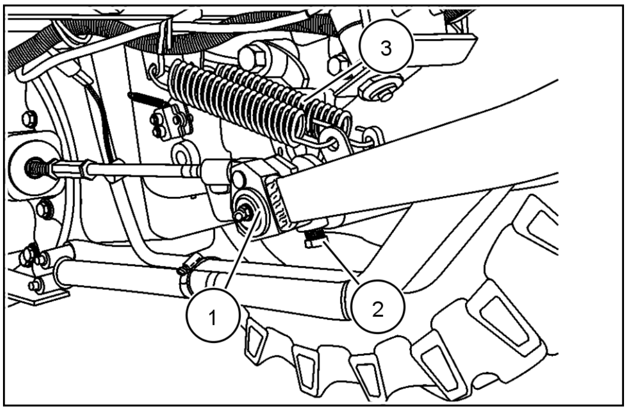
Prior operation:
Command - Inspect Clutch pedal (C.10.C)

1. Insert the shaft, **(1)**, through the clutch pedal support, **(2)**, and through the housing on the tractor.
2. Slide both the left-hand side and right-hand side brake pedals, **(3)**, onto the support shaft, **(1)**.
3. Install the washer, **(4)**, on the support shaft.



20098834 1

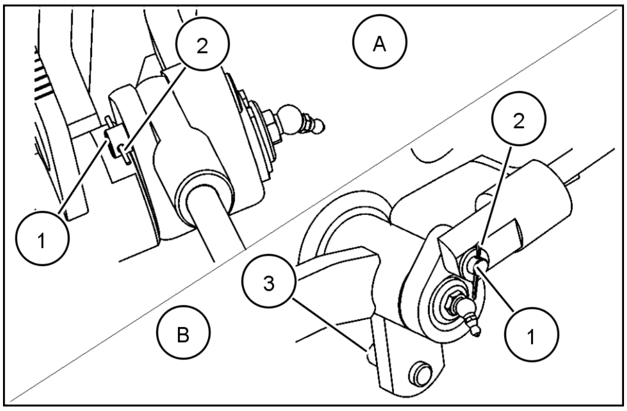
4. Install the circlip, **(1)**, on the end of the support shaft.
5. Install the conical screw, **(2)**, through the support shaft and left brake pedal.
6. Reconnect the brake pedal springs, **(3)**.



20098833 2

7. Attach the right-hand side **(A)** and left-hand side **(B)** brake linkage rods to the pedals.
8. Secure using the roll pin, **(1)**, and cotter pin, **(2)**.
9. Attach the clutch linkage to clutch pedal, **(3)**, and secure using the washer and cotter pin.
10. Reconnect the clutch pedal spring.

NOTE: *Check the brake pedal free play before operating tractor. Refer to* ***Command - Adjust Free play (D.30.B)****.*



20099884 3

Next operation:
Command - Adjust Clutch pedal setting (C.10.C)

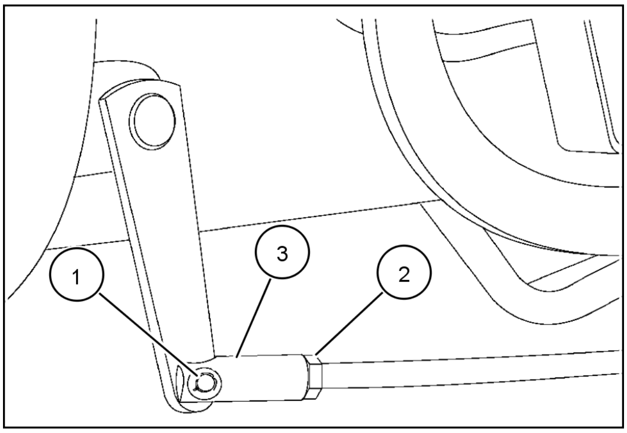
Command - Adjust Clutch pedal setting

Prior operation:
Command - Install Clutch pedal (C.10.C)

NOTE: *Clutch pedal free play should be* ***30 - 45 mm*** *(****1.18 - 1.77 in****)measuring at clutch pedal.*

To adjust the free play, proceed as follows:

1. Remove the split pin, **(1)**, and disconnect the linkage.
2. Loosen the lock nut, **(2)**.
3. Rotate the yoke, **(3)**, clockwise to reduce the play and counterclockwise to increase the play.
4. Connect linkage back to cross shaft.



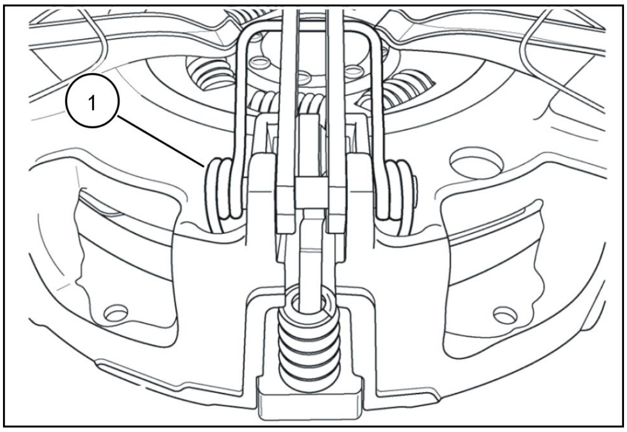
20097509 1

Next operation:
Clutch - Adjust PTO Clutch Adjustment (C.40.B)

Command - Disassemble Release Fingers

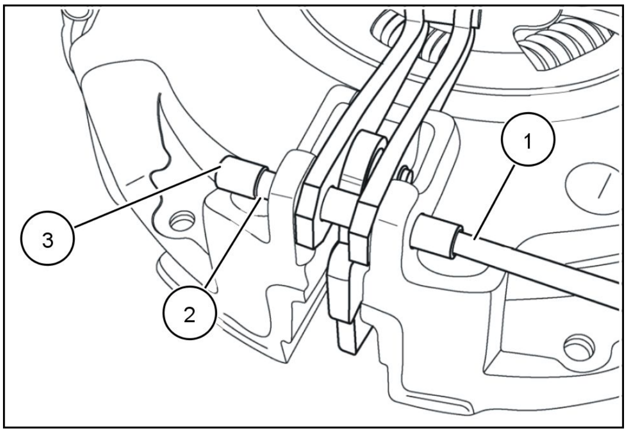
Prior operation:
POWER COUPLING Clutch - Disassemble Clutch Assembly (C.10.C)

1. Remove the spring, **(1)**, from the dowel pin.



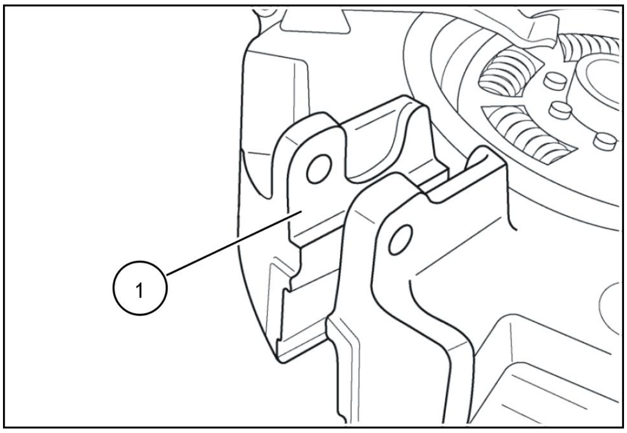
20097543 1

2. Using a punch, **(1)**, remove the release finger pin, **(2)**, and bushing, **(3)**.
3. Remove the finger from the mounting surface.



20097544 2

4. Inspect the mounting surface, **(1)**, for wear or damages and replace as needed.
5. Repeat the same procedure for the remaining fingers as required.



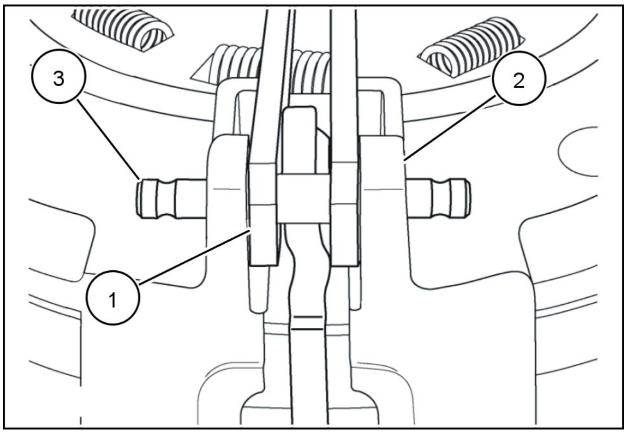
20097545 3

Next operation:
Command - Assemble Release Fingers (C.10.C)

Command - Assemble Release Fingers

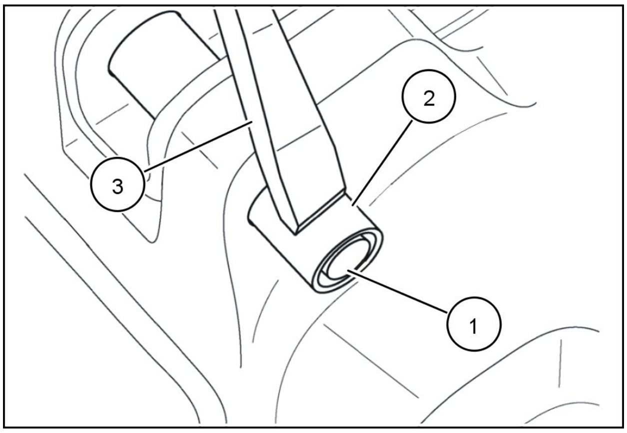
Prior operation:
Command - Disassemble Release Fingers (C.10.C)

1. Insert the new finger, **(1)**, into the mounting surface, **(2)**.
2. Insert pin, **(3)**, through the mounting surface and lever as shown.



20097546 1

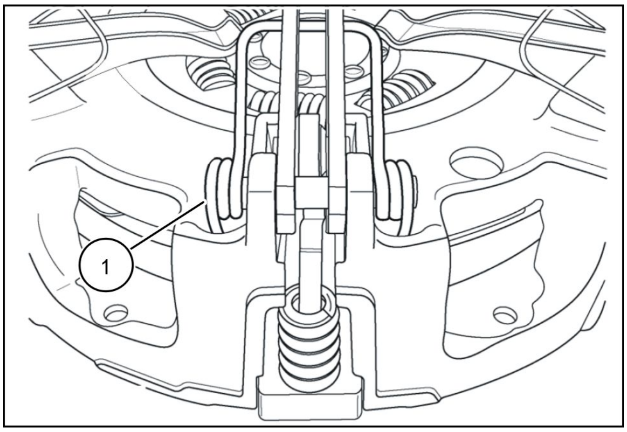
3. Secure the pin, **(1)**, with a new bushing, **(2)**, on each side, as shown.
4. Using a chisel, **(3)**, and form a notch into the bushing, **(2)**, to keep the bushings from coming off.



20097547 2

5. Install spring, **(1)**, as shown with spring riding on the under side of the lever.

NOTE: *Pay close attention as some levers will require the spring installed on the top side of the lever.*



20097543 3

Next operation:
POWER COUPLING Clutch - Inspect Clutch Assembly (C.10.C)

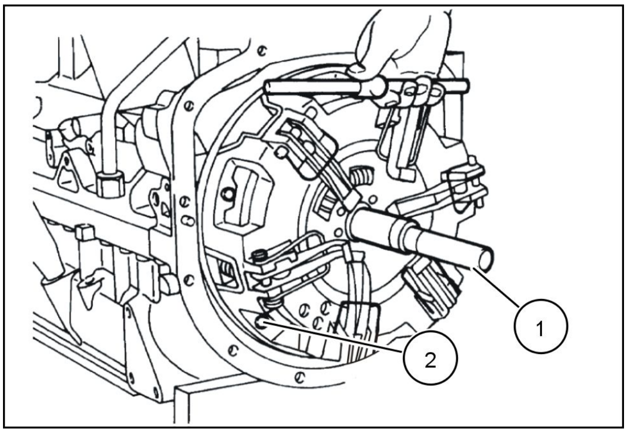
Command - Adjust Release lever height adjustment

Prior operation:
POWER COUPLING Clutch - Install Clutch Assembly (C.10.C)

1. After overhauling the clutch, fit aligning tool **380000652**, **(1)**, and fit the entire clutch assembly to the flywheel, then evenly tighten the bolts, **(2)**.

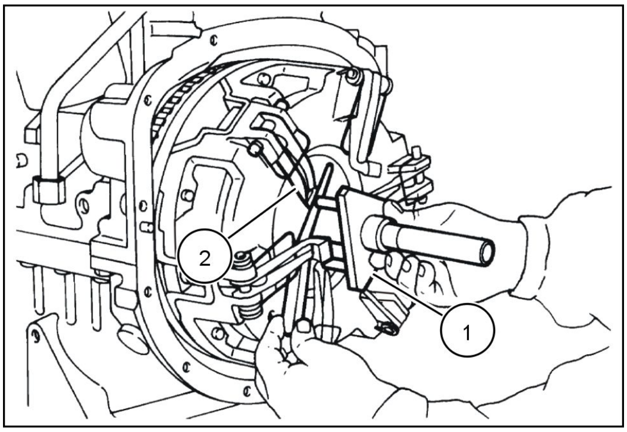
NOTE: *Double clutch aligning arbor set* ***380002740****consists of:*

- *Clutch alignment tool -* ***380000652***
- *Clutch finger height gauge -* ***380000653****.*



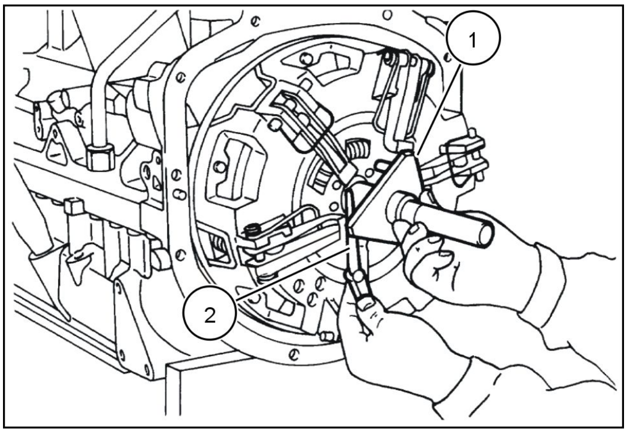
20097556 1

2. Fit gauge **380000653**, **(1)**, on the aligning arbor and adjust the clutch release levers, **(2)**, until no pressure is applied and all three fingers are set at same heights or are flush with pins on the tool.
3. Lock setscrews to hold adjustment.



20097557 2

4. Rotate the gauge, **(1)**, and adjust the PTO clutch release levers, **(2)**, until no pressure is applied and all three fingers are set at same height or are flush with tool plate.



20097558 3

POWER COUPLING Clutch - Troubleshooting

Problem	Possible Cause	Correction
Clutch slips	Clutch disc, pressure plate and/or flywheel wear.	Replace clutch disc; replace clutch if necessary and grind the flywheel.
	Damaged or bent or broken fingers.	Replace finger assembly.
	Oil or grease on friction material.	Replace clutch disc; repair leak of lubricant in to clutch housing; thoroughly clean friction surfaces.
Clutch grabs	Stiff external control linkage.	Check and lubricate linkage pivot points.
	Warped clutch disc.	Replace clutch disc.
	Clutch disc with damaged damper springs or loose hub.	Replace clutch disc.
	Oil or grease on friction material.	Replace clutch disc; repair leak of lubricant in to clutch housing; thoroughly clean friction surfaces.
	Finger springs broken.	Replace finger springs.
Clutch fails to disconnect and drags	Warped clutch disc.	Replace clutch disc.
	Damaged clutch release bearing.	Replace clutch release bearing.
	Damaged finger spring.	Replace finger springs.
Clutch noise at engagement and / or disengagement	Warped clutch disc.	Replace clutch disc.
	Damaged clutch disc damper springs.	Replace clutch disc.
	Excess backlash on clutch disc to hub meshing splines.	Replace clutch disc and shaft, as necessary.
Clutch noise at disengagement	Worn clutch release bearing.	Replace bearing.
Clutch control pedal hardness	Hard pedal.	Check and lubricate linkage.
	Broken or disconnected clutch return spring.	Repalce or hook-up clutch return spring.

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TRANSMISSION, DRIVE AND PTO OUT - C

TRANSMISSION Mechanical - 20.B

Workmaster 45
Workmaster 55

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TRANSMISSION Mechanical - General specification

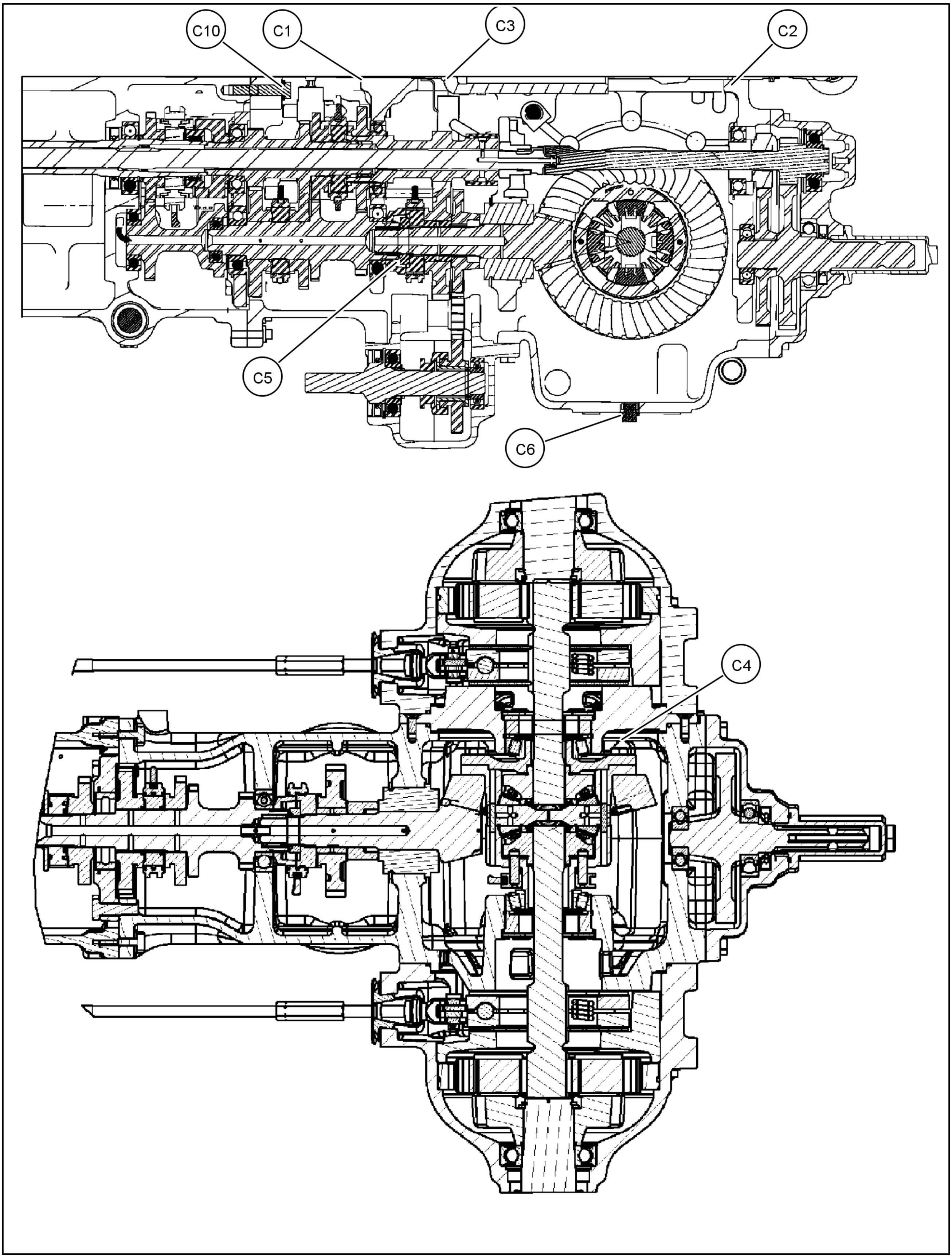
Gear box type	Constant mesh
Gear type	Spur gears Ist/2nd, Helical 3rd/4th
Range gears	Constant mesh
Gear type	Spur Gears
Lubrication	
Transmission oil capacity	APGL4SAE 20W30 **23 l** (**6 US gal**)

		35 HP REG HELICAL	35-37 HP REG HELICAL SLOW	35 HP HX HELICAL SLOW	42 HP REG-HX HELICAL
Engine rpm		**2000 RPM**	**2000 RPM**	**2000 RPM**	**2000 RPM**
Total Reduction.					
	L1	160.17	181.24	181.24	160.17
	L2	106.34	120.34	120.34	106.34
	L3	72.03	81.51	81.51	72.03
	L4	52.36	59.25	59.25	52.36
	H1	44.15	49.96	49.96	44.15
	H2	29.31	33.17	33.17	29.31
	H3	19.85	22.47	22.47	19.85
	H4	14.43	16.33	16.33	14.43
	LR	130.51	147.69	147.69	130.51
	HR	35.97	40.71	40.71	35.97

Engine Speed					
	540 RPM (std.) PTO speed	**1747 RPM**	**1747 RPM**	**1747 RPM**	**1747 RPM**
	540E RPM rpm (economical) PTO speed	**1227 RPM**	**1227 RPM**	**1227 RPM**	**1227 RPM**

TRANSMISSION Mechanical - Torque

Description	Thread size mm	Torque Nm
Gear shift lever cover bolts **(C1)**	M8	**24.5 N·m** (**18 lb ft**)
Hydraulic housing on transmission retainer bolts **(C2)**	M10 X 1.25	**59 N·m** (**44 lb ft**)
Hydraulic housing on transmission retainer bolts **(C3)**	M12 X 1.25	**98 N·m** (**72 lb ft**)
Ring gear bolts **(C4)**	M 10	**59 N·m** (**44 lb ft**)
Pinion lock nut **(C5)**	M 35	**294 N·m** (**217 lb ft**)
Drain plug **(C6)**	M 22	**44 N·m** (**32 lb ft**)
PTO cover bolts **(C7)**	M12 X 1.25	**88 N·m** (**65 lb ft**)
Rear axle to Transmission housing attaching bolts **(C8)**	M12 X 1.25	**98 N·m** (**72 lb ft**)
Front cover bolts **(C9)**	M12 X 1.25	**98 N·m** (**72 lb ft**)
Transmission housing to Clutch housing attaching bolts **(C10)**	M12 X 1.25	**88 N·m** (**65 lb ft**)
Differential lock pedal screw **(C11)**	M10 X 1.25	**59 N·m** (**44 lb ft**)



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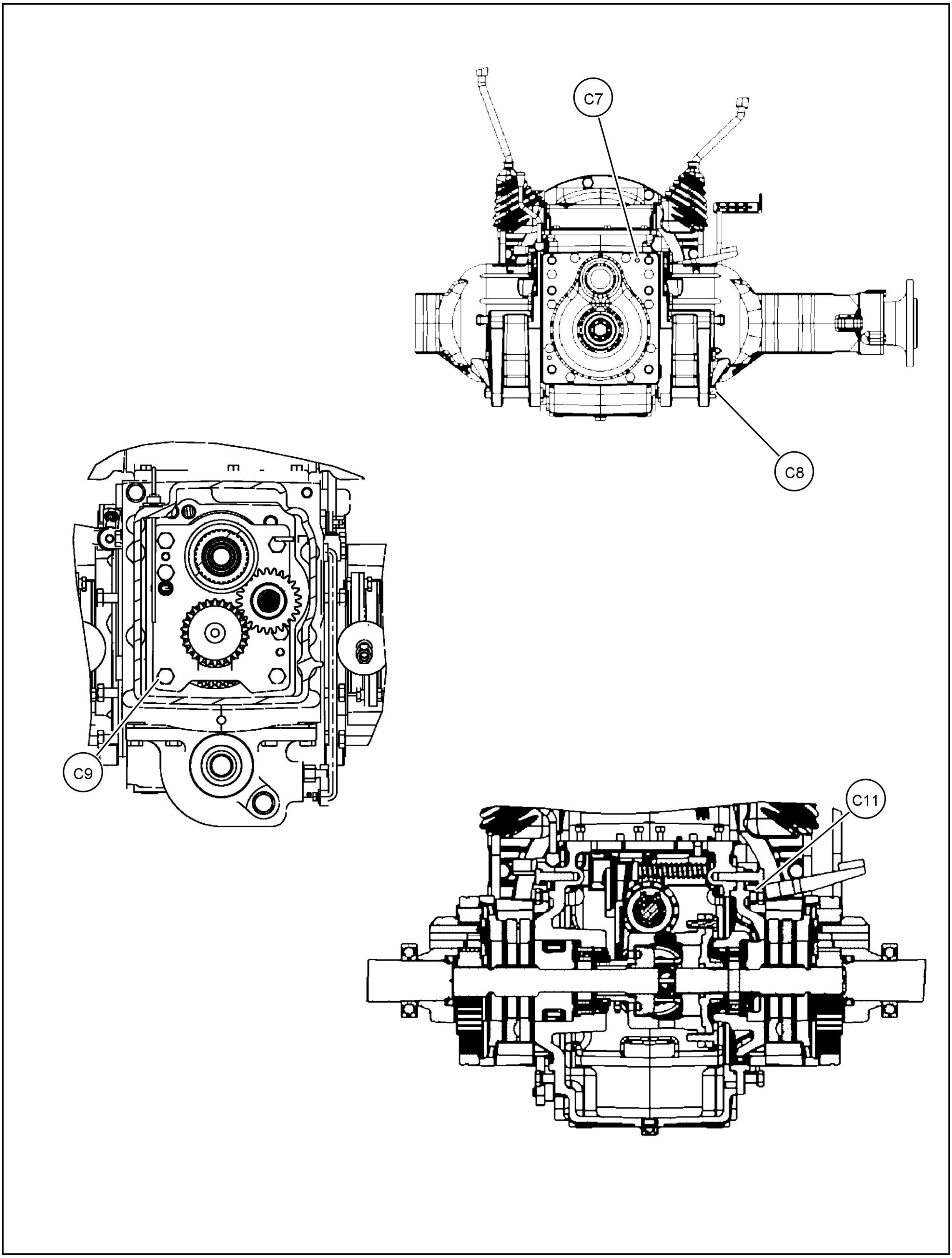
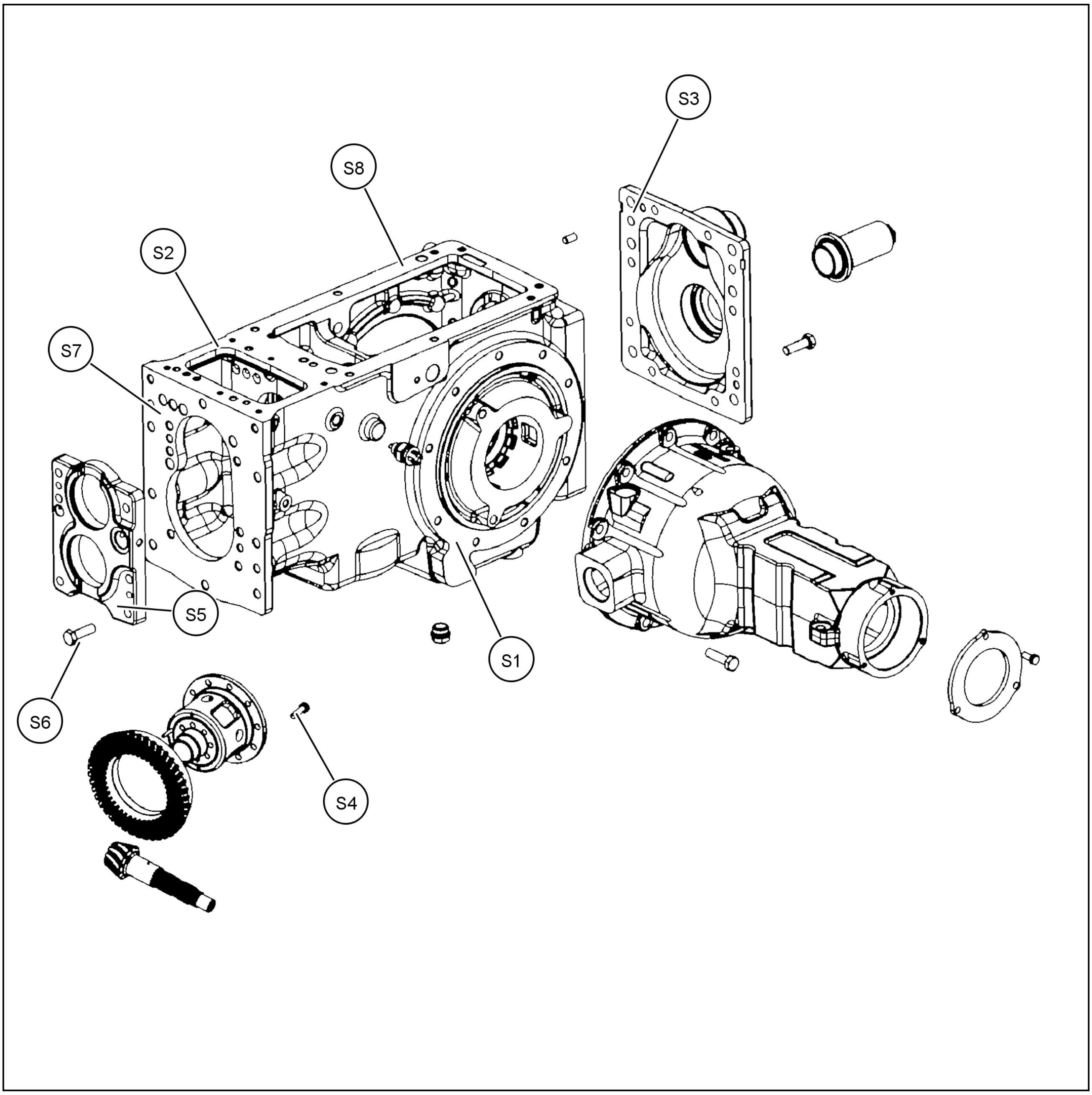


20099981 2

TRANSMISSION Mechanical - Sealing

Operation Description	Sealant Specification
Rear axle to transmission housing **(S1)**	**LOCTITE® 518**
Gear shift lever cover **(S2)**	**LOCTITE® 518**
PTO cover plate **(S3)**	**LOCTITE® 518**
Crown wheel bolts **(S4)**	**LOCTITE® 243**
Front cover plate **(S5)**	**LOCTITE® 518**
Front cover bolts **(S6)**	**LOCTITE® 243**
Transmission to Clutch housing **(S7)**	**LOCTITE® 518**
Lift housing to Transmission housing **(S8)**	**LOCTITE® 518**

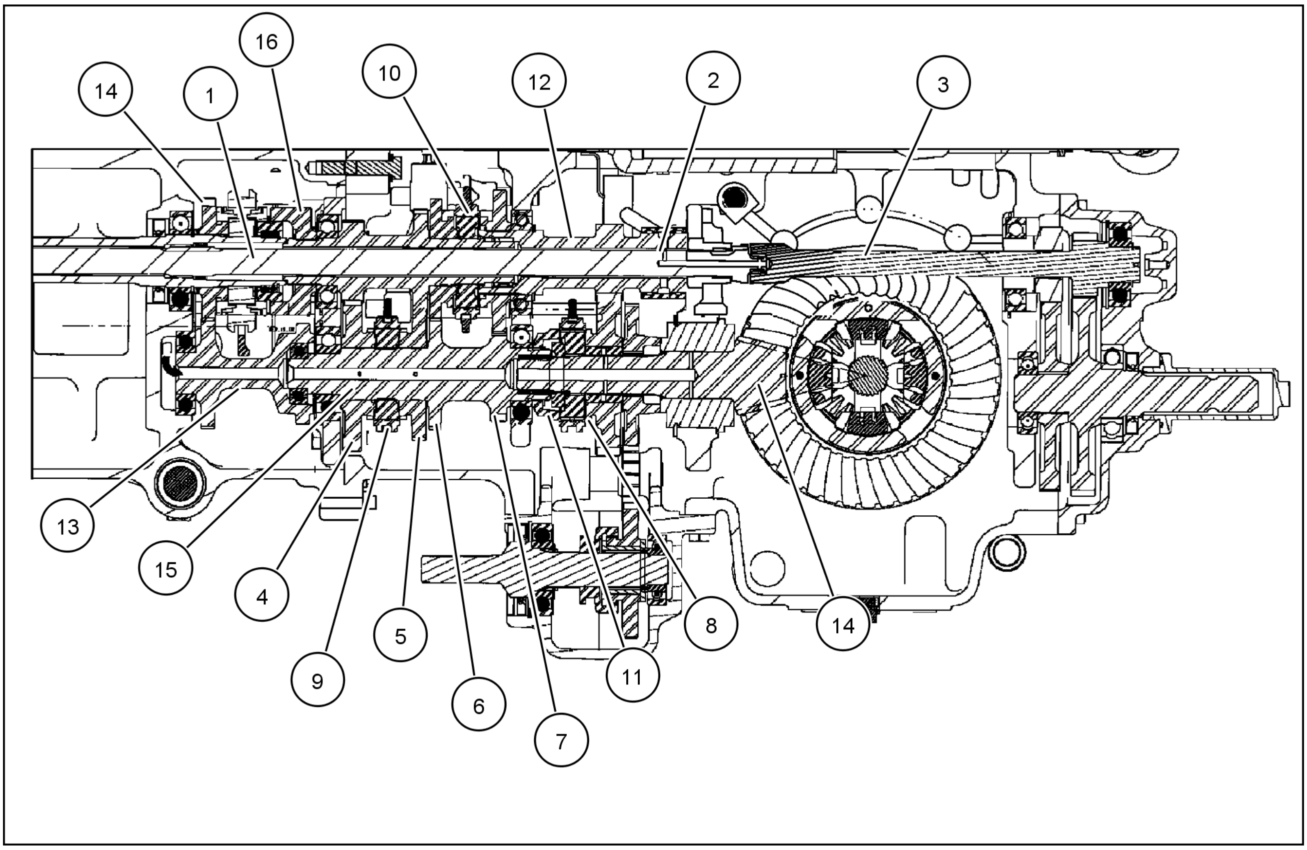


20097811 1

TRANSMISSION Mechanical - Special tools

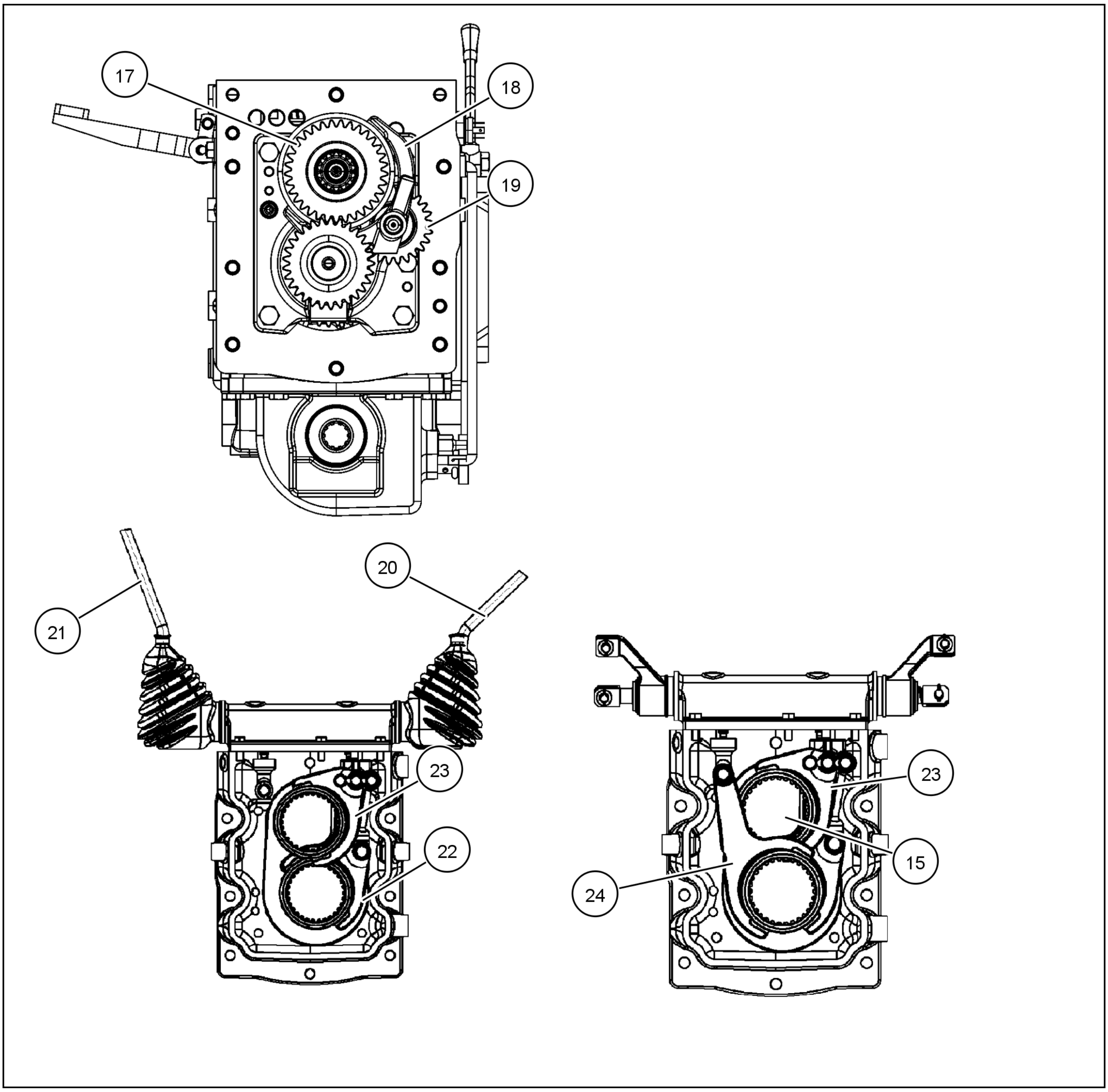
Tool Description	Tool No.
Socket pinion check nut	380002982
Pinion locking tool	380002985
Mandrel with extension	380002986
Special snap ring remover	Procure locally
Nut Un-Staking tool	380000660

TRANSMISSION Mechanical - Sectional view



200900178 1

1.	Drive shaft	9.	1st - 2nd gear coupler
2.	Range shaft	10.	3rd - 4the gear coupler
3.	PTO input shaft	11.	Hi - Lo gear coupler
4.	1st gear	12.	Low gear on range shaft
5.	2nd gear	13.	Cluster gear
6.	3rd gear	14.	Pinion shaft
7.	4th gear	15.	Driven shaft
8.	Low gear on pinion shaft	16.	Reverse gear

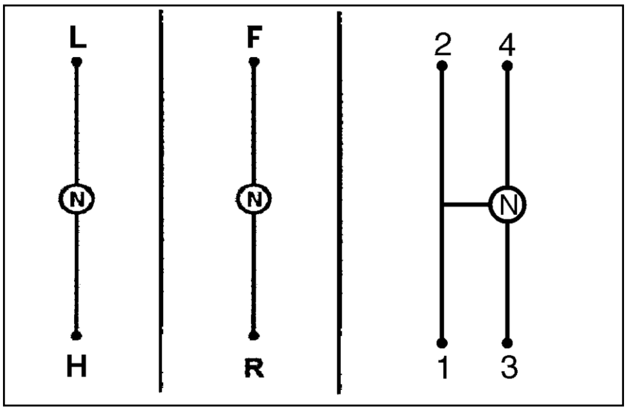


200900179 2

17. Reverse drive gear
18. Range gear shift fork
19. Reverse intermediate gear
20. Hi-Lo gear shift lever
21. Range gear shift lever
22. 1st - 2nd gear shift fork
23. 3rd - 4th gear shift fork
24. Hi - Lo gear shift fork

TRANSMISSION Mechanical - Dynamic description

The transmission has eight forward and eight reverse gears. The gear shift levers, operate in an H-Pattern.



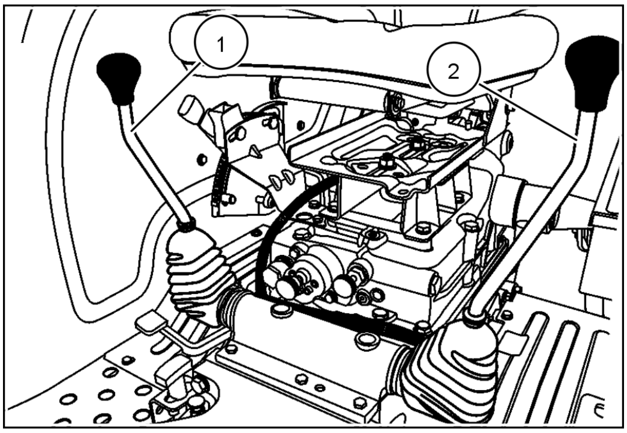
200900176 1

⚠ WARNING ⚠

Before leaving the machine, lower attachments, place all controls in neutral, set the parking brake, stop the engine and remove the key and wait for all movement to stop. Failure to comply could result in death or serious injury.

M224E

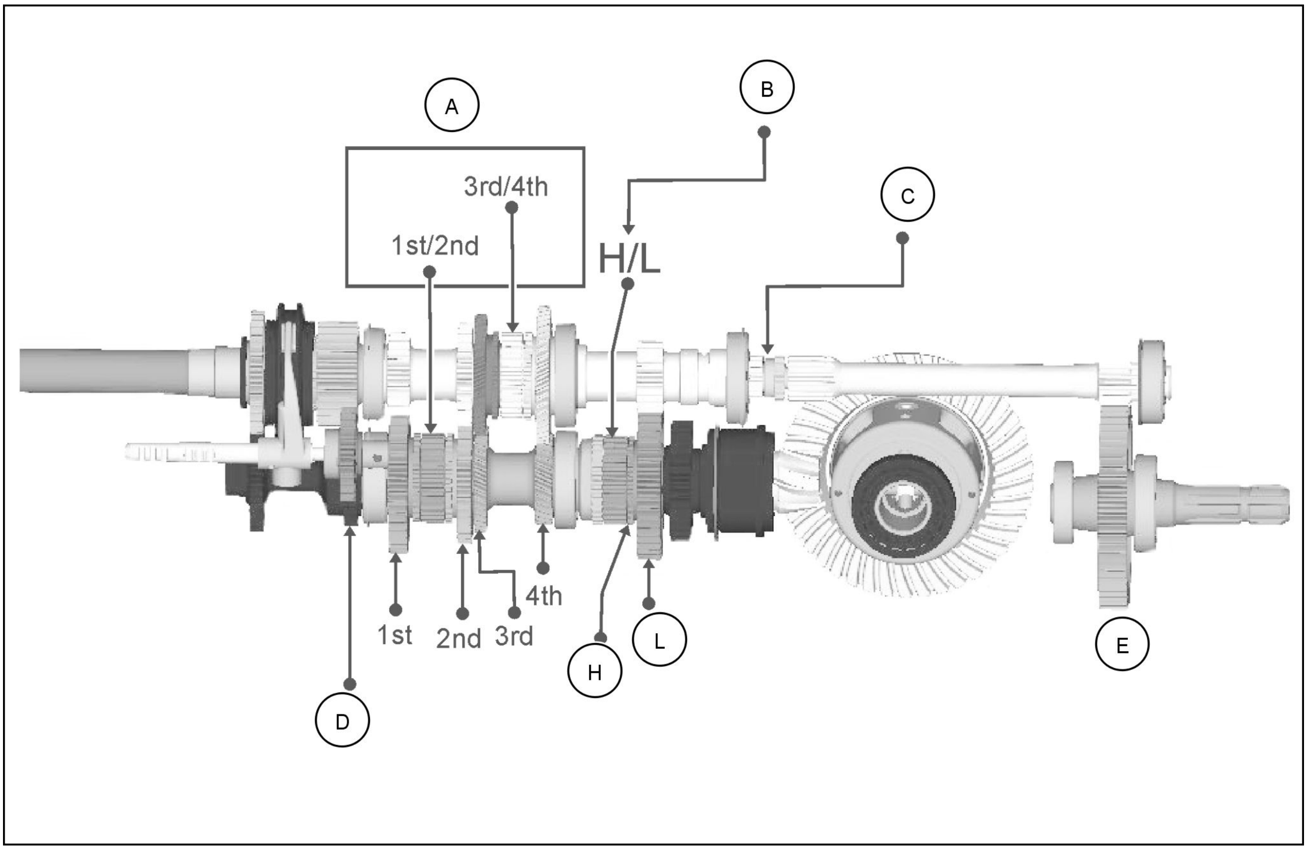
The main gear shift lever, **(1)**, is used to select any one of the forward gears or reverse gears. The Hi-Low selector lever, **(2)**, is used to select the high or low range, which gives double the number of available gears.
To change gear range; depress the clutch pedal, stop the tractor and move the Hi-Low selector lever backward for high or forward low.
To change the gears in the selected range; depress the clutch pedal and shift main gear lever in the normal way.



20097815 2

NOTE: *A safety start switch prevents operation of the starter motor unless the transmission range lever is in neutral position (N).*

NOTE: *If it is necessary to tow the tractor, the Hi-Low selector and both main gearshift levers must be in neutral*



200900298 3

Double Speed - Gearbox

(A) Main gear lever
(B) Range selector lever
(C) PTO lever
(D) Reverse
(E) PTO 540 @ 2555
(H) High
(L) Low

Referring to Figures in **TRANSMISSION Mechanical - Sectional view (C.20.B)** , **3**, **4**, and **5** the transmission has an input shaft called drive shaft, **(1)**, and range shaft, **(2)**, driven shaft, **(15)**, and pinion shaft **(14)**,.1st **(4)**, 2nd **(5)**, gears are integral part of the drive shaft and 3rd **(6)**,4th **(7)**, gears are integral part of driven shaft. All gears of input shaft and driven shaft are constant mesh , high gear is assembled in driven shaft, while, low gear, **(8)**, is fitted on the pinion shaft. Low drive gear, **(12)**, is part of the range shaft is in constant mesh with low gear on pinion shaft.

The speeds are shifted by meshing gears 1st **(4)**, 2nd **(5)**, 3rd **(6)**, and 4th **(7)**, in succession with the gearbox driven shaft. This is done by means of gear couplers, **(9)**, and **(10)**. If coupler, **(9)**, is shifted, say to the left, its internal teeth will connect additional gear ring of 1st gear, **(4)**, with toothed bushings secured on the driven shaft. As a result, 1st gear **(4)**, will rotate together with the driven shaft and transmit rotation to pinion shaft via range shaft, **(2)**. When gear coupler, **(9)**, is shifted to the right, the driven shaft will become rigidly connected with 2nd gear, **(5)**, having a larger number of teeth than 1st gear. As a consequence, the pinion shaft will rotate faster than the previous speed.

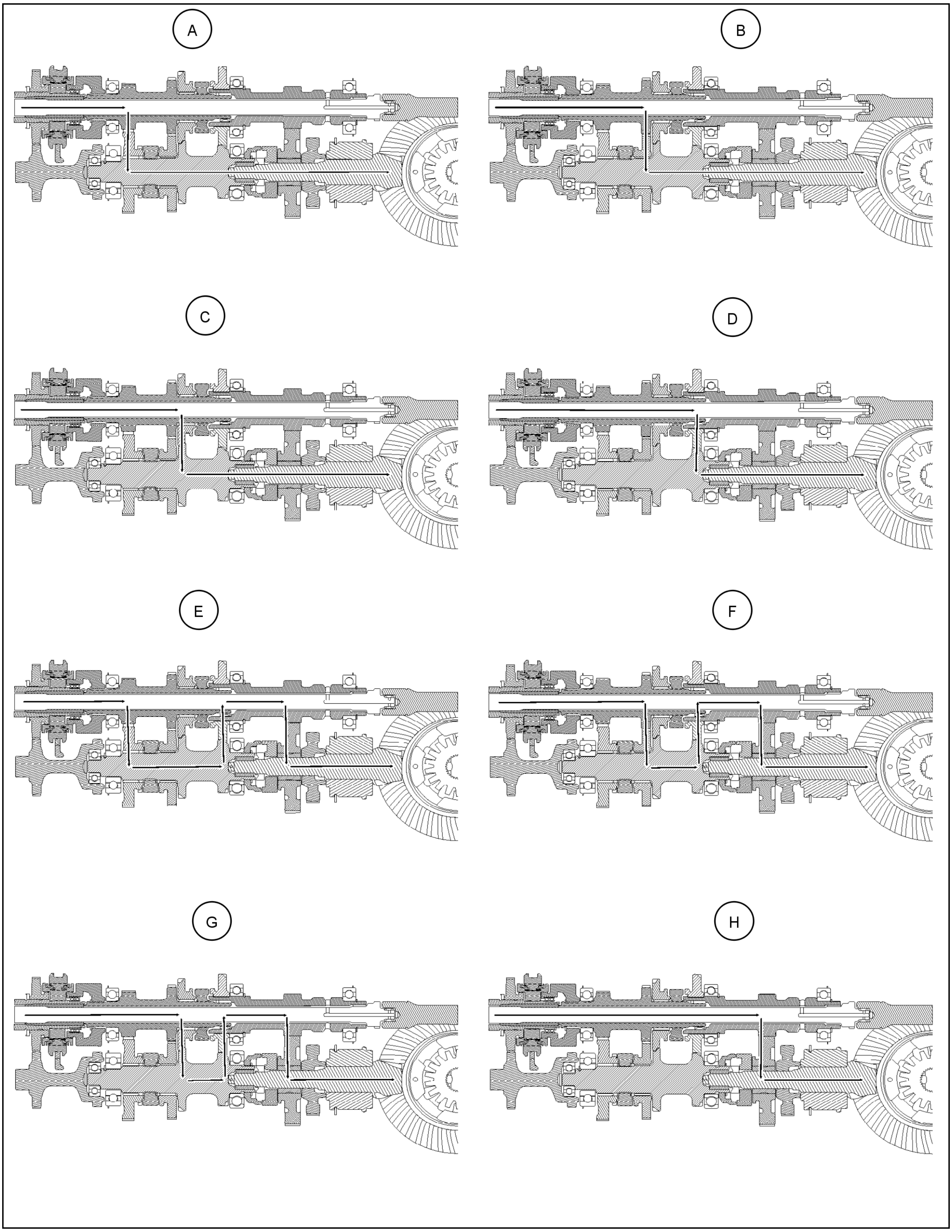
Similarly by shifting gear coupler, **(10)**, to left pinion shaft is driven by 3rd gear, **(6)**, via range shaft and by shifting to right pinion shaft is driven by 4th gear, **(7)**, via range shaft and speed of the pinion shaft varies according to the number of teeth on the gears, **(6)**, and **(7)**.

Range gear can be selected by shifting the range gear coupler, **(11)**, to left or right. For getting high range, shifting coupler to left engages cluster gear directly to pinion shaft and pinion shaft receives the rotation from any one of the gears 1st,2nd ,3rd and 4th depending on the position of gear couplers, **(9)**, and **(10)**, through driven shaft, **(15)**, and range shaft, **(2)**.

For low gear range coupler, **(11)**, have to be shifted to right and pinion shaft receives rotation via driven shaft, **(15)**, and range shaft, **(2)**. Since gear, **(12)**, has less number of gears teeth, as a consequence, the pinion shaft will rotate slower than high range.

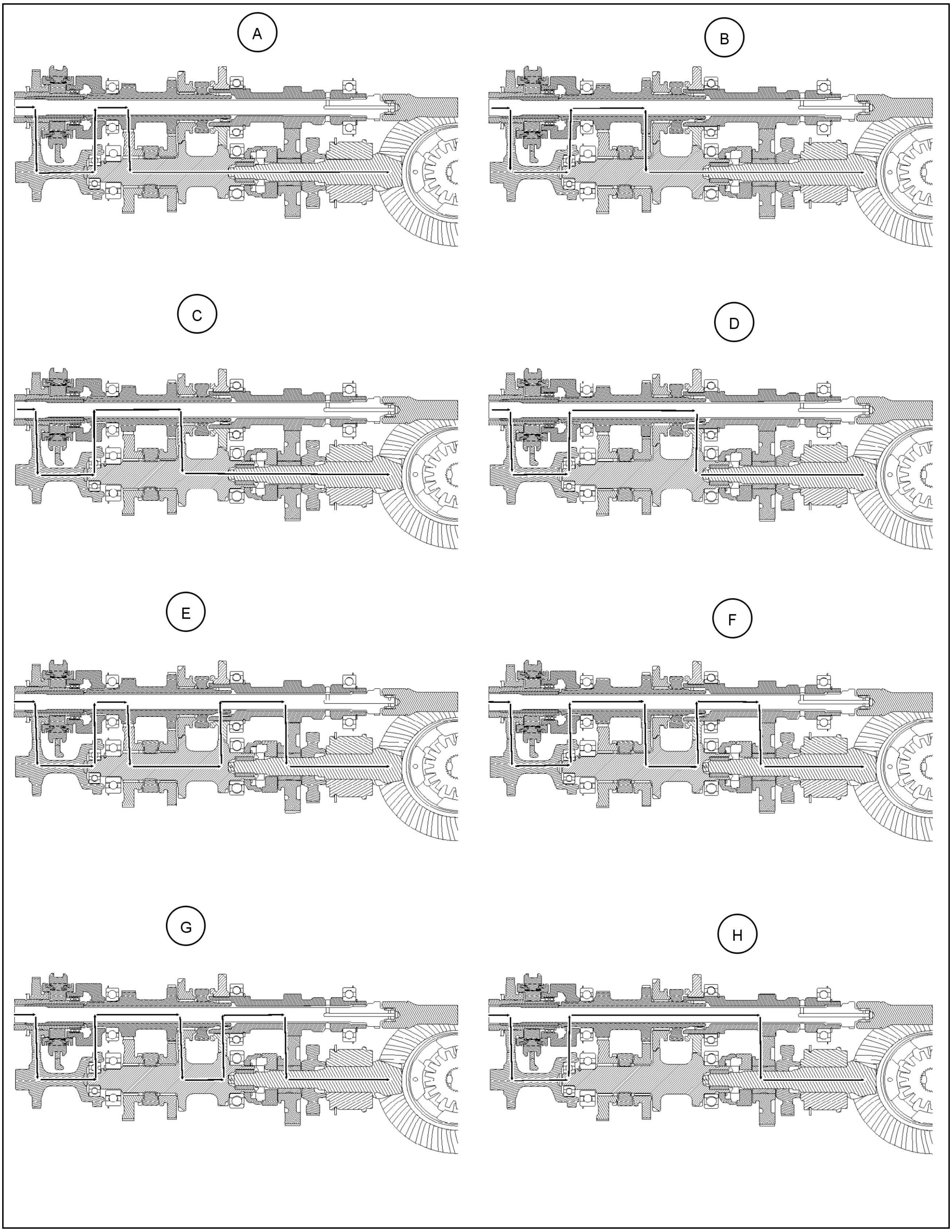
For high gear range coupler, **(11)**, have to be shifted to the left and pinion shaft receives a rotation directly from driven shaft, **(15)**.

For engaging reverse gear, shift main gear shift lever to backward, power flow is from input shaft via cluster assembly is transmitted to reverse drive, **(17)**, to cluster gear, **(13)**, to gear coupler, **(9)**, to reverse gear, **(16)** and changes the direction of rotation of pinion shaft. Depending on the position of range gear coupler, **(11)**, all the various high reverse or low reverse are obtained.



20099961 4

A - FORWARD H1
B - FORWARD H2
C - FORWARD H3
D - FORWARD H4
E - FORWARD L1
F - FORWARD L2
G - FORWARD L3
H - FORWARD L4



20099962 5

A - REARWARD H1
B - REARWARD H2
C - REARWARD H3
D - REARWARD H4
E - REARWARD L1
F - REARWARD L2
G - REARWARD L3
H - REARWARD L4

GENERAL RECOMMENDATIONS FOR OVERHAULING OPERATIONS

NOTE: *Please read this carefully before starting assembly or disassembly operations.*

Precaution at flange and tool ends

While hammering at flange and tool ends during removal or installation, attention must be paid to the various phases. Functioning and integrity of tool as well as various components must not be endangered.

Reassembling methods

Adequate holding equipment should be used for reassembling group.

Lifting system will be necessary for reconnecting, disassembling and reassembling the ring gear or for holding the gearbox.

Use cross section drawings to ease assembly and disassembly operations.

Recommendations regarding lubrication.

It is very important to use proper lubricants and to maintain a constant level of correct lubrication.

Right operational temperature is to be maintained.

Shaft seals

Respect the following recommendations during seal and gasket assembly:

- Clean shaft very carefully and ensure that the part in contact with the rings is not damaged, cut or out of roundness.
- Assemble the seals so that the lips is fitted towards the oil side.
- Lubricate seal lips (use oil) and fill 3/4 of seal cavity with grease.
- Use appropriate driver. Do not use a hammer directly on the seals.
- Do not damage the seals while assembling the shaft.

O-ring

Lubricate adequately before inserting them at the right place so as to avoid rolling while assembling shaft.

Bearings

Use correct pullers for bearings removal.
Clean, lubricate and inspect well before reassembling the bearings.
The spiral elastic pins do not need such adjustment.

Sealing

Use sealants as specified. Ensure that parts to be sealed are clean, dry and grease free.

Oil drain

Before disassembly, oil should be drained out from the group.

⚠ WARNING ⚠

Engine oil is a toxic substance. Dispose of used oil properly. Contact your dealer or recycling center for approved disposal methods. Failure to comply could result in an environmental hazard, death or serious injury.

M1387

Cleaning

- All parts in motion (gears, bearings, etc) are to be washed accurately with parts cleaning solution.
- Petrol and watery alkaline solutions are to be avoided.
- Do not wash with stream or hot water as it will be very difficult to eliminate surface humidity.
- Dry all parts with a rag or air jet to avoid scratching from abrasive residuals.
- All surfaces should be covered with lubricant so as to protect it from future oxidation.

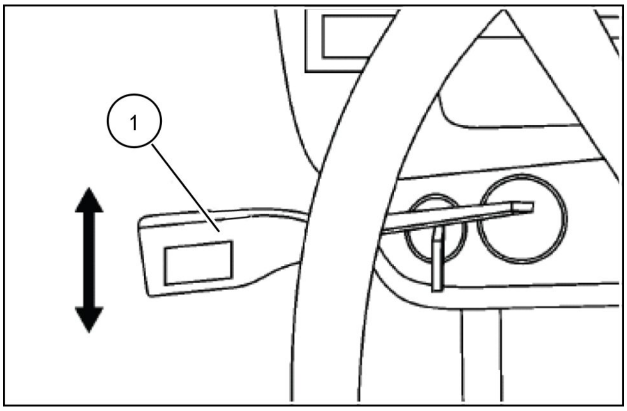
Inspections

- Examine accurately that all bearings, external rings which may be still stuck in their position; pivot pins on which rolls rotate and replace those which are worn out or damaged.
- Gears should not be damaged and teeth should not be excessively worn. Teeth smoothing should not be deteriorated.
- Control all grooves: assure that they are not worn out or damaged.
- Replace damaged parts with original spare parts.
- Replace seals on rotating shaft, after disassembly.

TRANSMISSION Mechanical - Static description 8 X 8 Shuttle Transmission

The synchro shuttle transmission is ideal for application which require frequent changes of direction. The operator has to press clutch pedal and move shuttle lever to change direction of travel. Shift lever, **(1)**, to front for forward and rear to get reverse direction.

NOTE: *The shuttle lever must be in the neutral (middle) position to activate the safety start system, which allows the engine to start.*

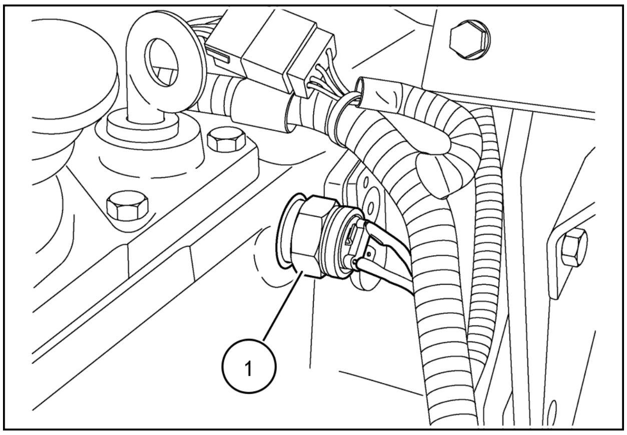


20099937 1

Sensing system - Static description Transmission range safety switch

The transmission range safety switch, **(1)**, is a single-pole, single-throw, switch located along the left side of the transmission. The switch is activated by the range shift lever. When the range is in neutral, the switch is closed to allow current to flow to the neutral start relay.

NOTE: *The range shift rail operates the safety switch. Notches in the shift rail accept the balk pin, extending the plunger in the safety switch, when the range lever is in the neutral position, This completes the circuit and allows the tractor to start.*



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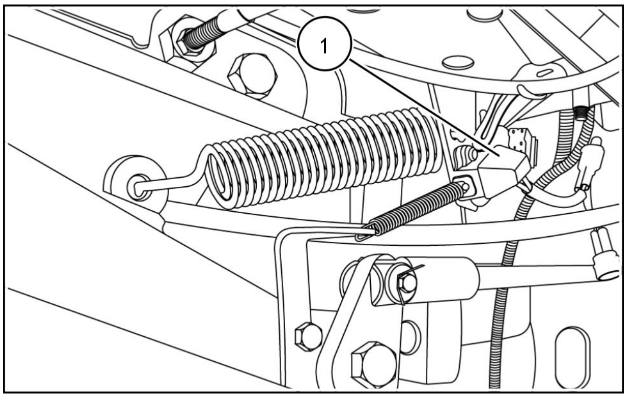
Sensing system - Static description Transmission clutch safety switch

The transmission clutch safety switch, **(1)**, is a single throw-style switch, located underneath the left side platform of the tractor. The switch is activated by the clutch pedal. When clutch pedal is depressed, the switch closes completing the circuit.



20098359 1

TRANSMISSION Mechanical - Remove Transmission assembly

Prior operation:
TRANSMISSION Mechanical - Dynamic description (C.20.B)

⚠ WARNING ⚠

Handle all parts carefully. Do not put your hands or fingers between parts. Always wear suitable safety items such as fitted clothing, safety goggles, gloves, shoes, etc. Failure to comply could result in death or serious injury.

M954A

⚠ WARNING ⚠

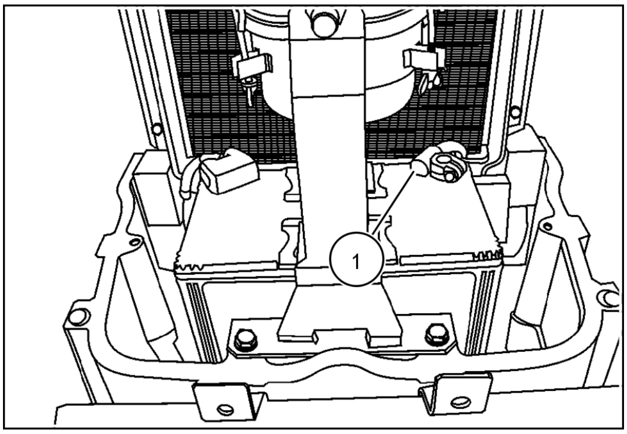
Lift and handle all heavy components using lifting equipment of appropriate lifting capacity. Ensure that units or parts are supported by suitable slings or hooks. Ensure that no persons or pets are in the vicinity of the load to be lifted. Failure to comply could result in death or serious injury.

M1258

NOTE: *To remove the transmission housing from the tractor, the tractor has to be split at the clutch and transmission housing and fenders, hydraulic housing, three point linkage, rear tire's and final drive housings have to be removed from the tractor.*

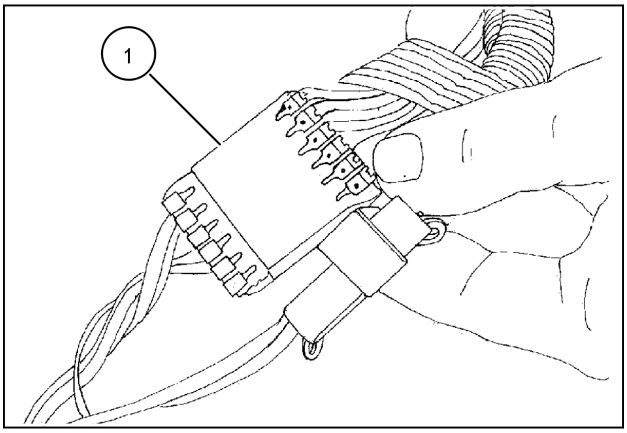
Remove the transmission assembly from the tractor as below:

1. Disconnect the negative battery cable, **(1)**, from the negative battery terminal.



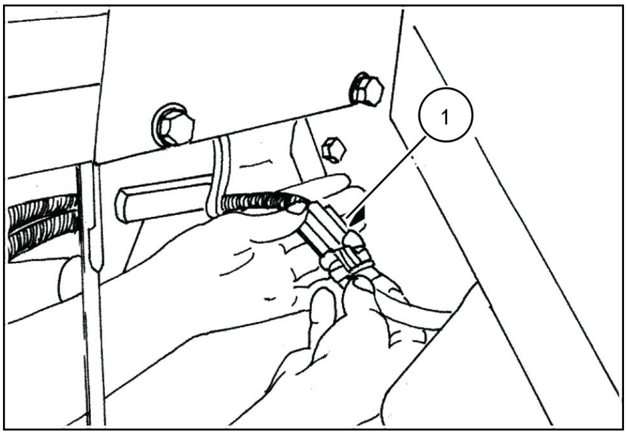
20097818 1

2. Disconnect the front wire harness connector, **(1)**, located under the steering column side panels from the rear wire harness connector.



20097819 2

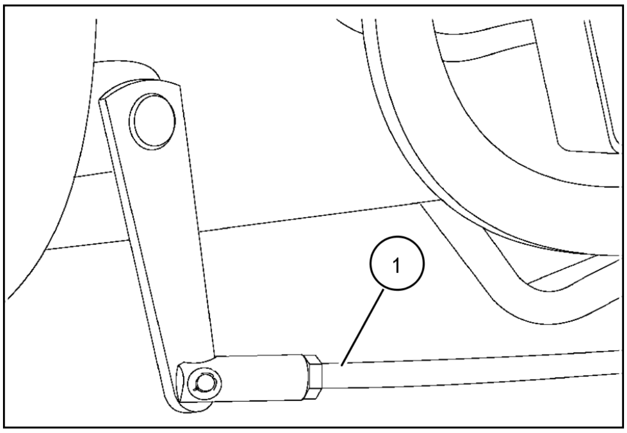
3. Disconnect the wire harness connector, **(1)**, between left-hand and right-hand side fenders.



20093437 3

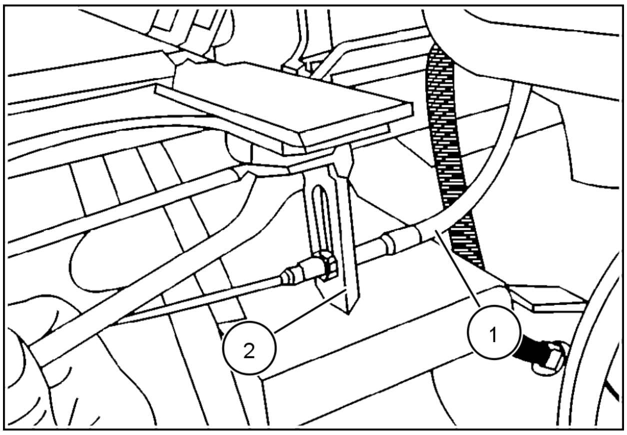
4. Disconnect clutch linkage, **(1)**.

NOTE: *Disconnect the brake linkage rods from the brake pedals. Refer to:* ***Command - Remove Brake pedals and external linkages (D.30.B)***



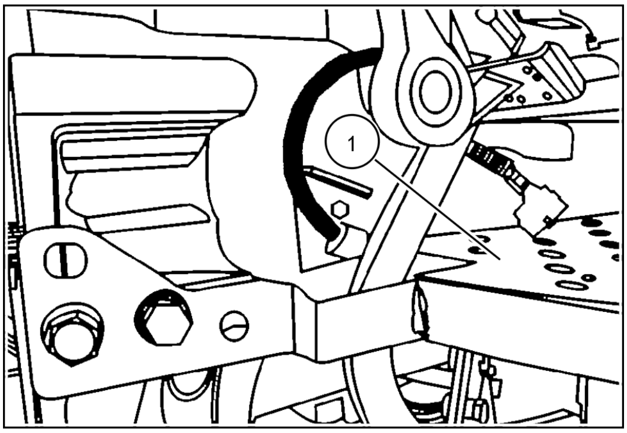
20097509 4

5. Disconnect foot throttle linkage, **(1)**, from the bracket, **(2)**.



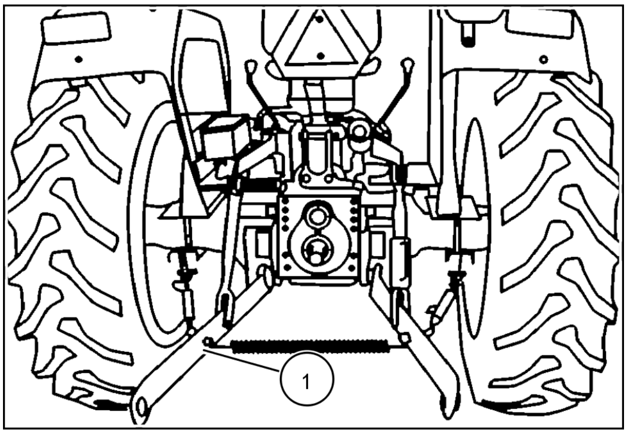
20097808 5

6. Loosen bolts securing foot boards, **(1)**, on left-hand and right-hand fenders and transmission housing.



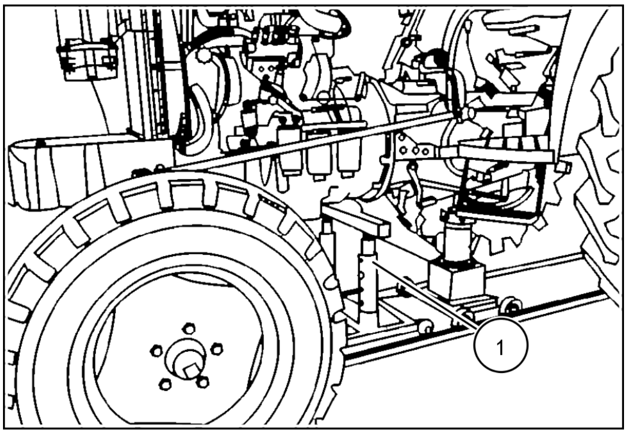
20097820 6

7. Remove the three point linkages, **(1)**, from the tractor.



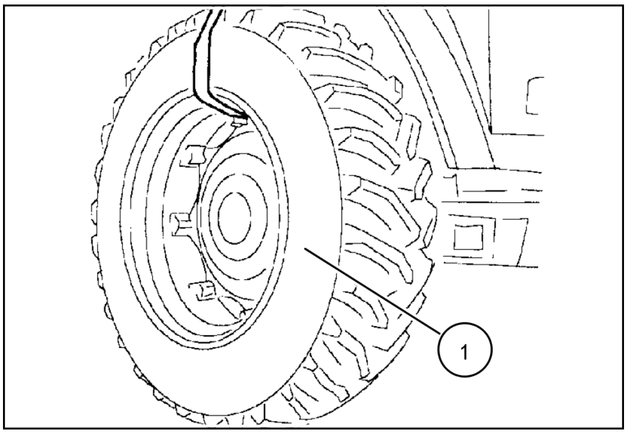
20097823 7

8. Place splitting trolley, **(1)**, under the tractor. Place suitable jack stand under both final drive housings.



20097824 8

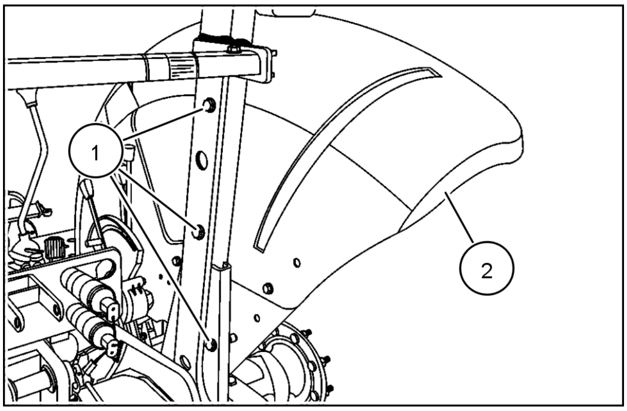
9. Remove both left-hand and right-hand side wheels, **(1)**.



20096210 9

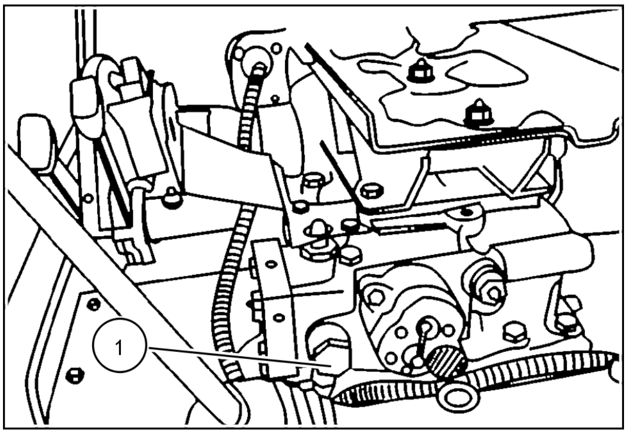
10. Remove the rear fenders from the tractor, refer to: **Protective shield - Remove REAR WHEEL FENDERS (E.20.A)**.
11. Remove the nuts, **(1)**, and bolts used to attach the rops to the axle housing. Refer to: **ROPS - Remove ROLL-OVER PROTECTION BAR (E.34.A)**.

NOTE: *Drain the oil from the transmission housing.*



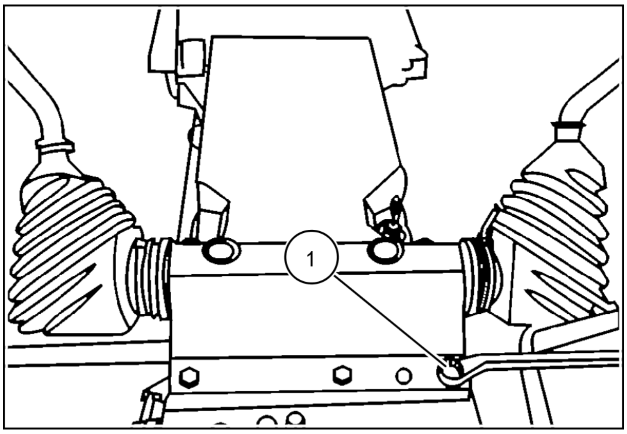
20099840 10

12. Disconnect the hydraulic lines, **(1)**, connecting the pump and hydraulic distributor.



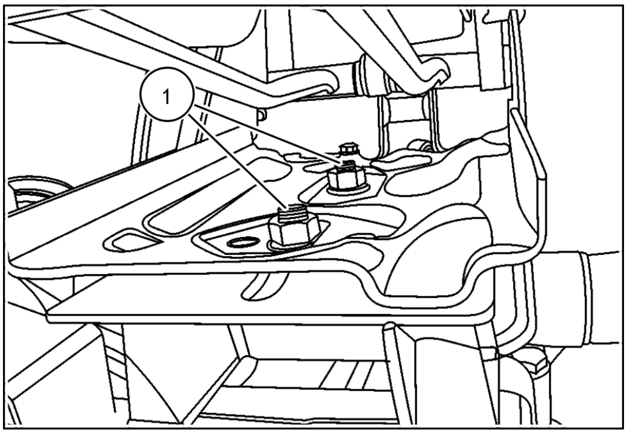
20097822 11

13. Loosen the gear box cover bolts, **(1)**, and remove cover.



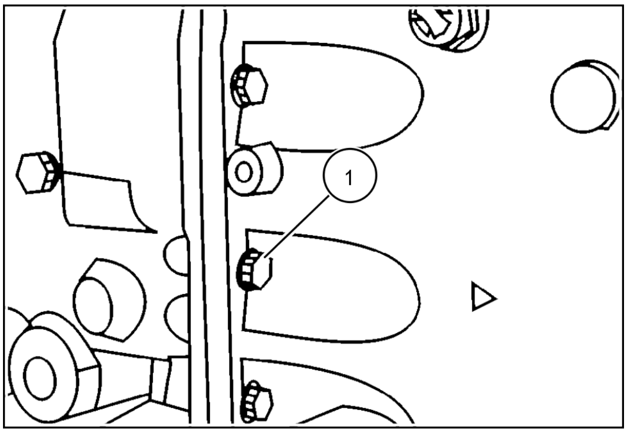
20097827 12

14. Loosen the bolts, **(1)**, and remove operator seat from the hydraulic housing.



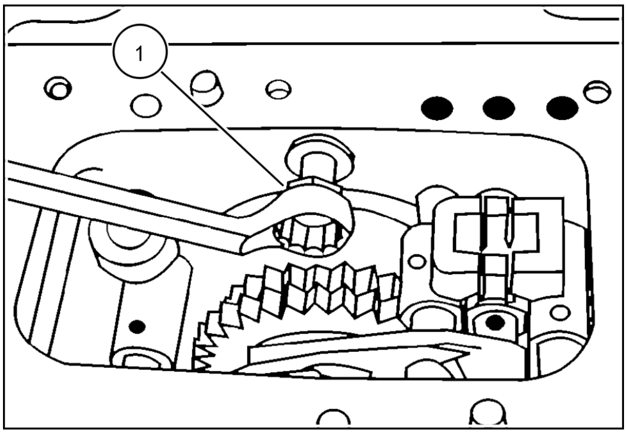
20097825 13

15. Loosen the transmission and centre housing coupling bolts, **(1)** and lift the assembly using a suitable hoist.



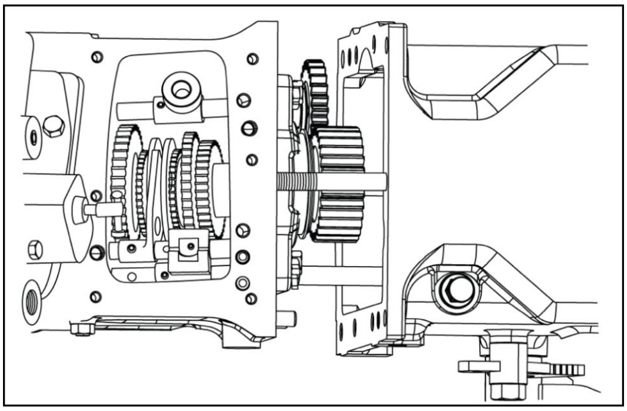
20097826 14

16. Loosen the bolt, **(1)**, before separating the transmission housing from clutch housing.



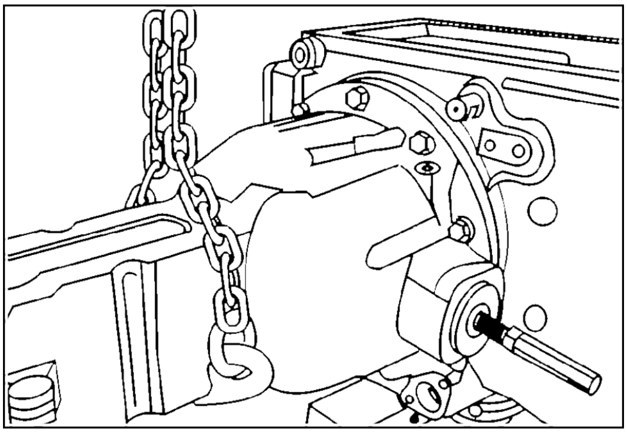
20097828 15

17. Separate the clutch and transmission housing.



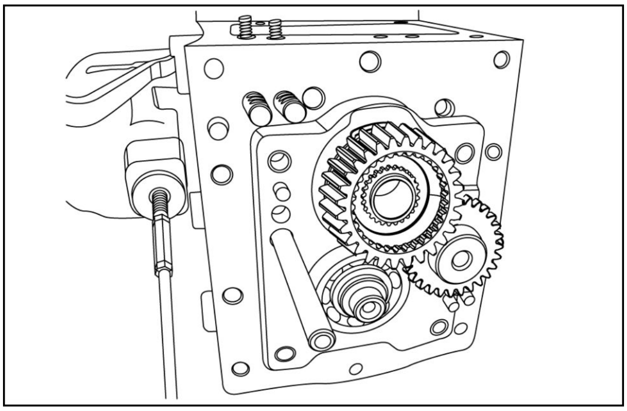
20099992 16

18. Wrap chain or nylon rope on the final drive housing and connect it to a hoist. Loosen the attaching bolts and remove the final drive housing.
19. Repeat for the final drive housing on the other side.
20. Loosen the bolts securing hydraulic housing on transmission housing and lift the housing using suitable hoist.



20097830 17

21. Place transmission housing on a suitable stand.



20099990 18

Next operation:

TRANSMISSION Mechanical - Disassemble Intermediate plate (C.20.B)

TRANSMISSION Mechanical - Disassemble Intermediate plate

Prior operation:
TRANSMISSION Mechanical - Remove Transmission assembly (C.20.B)

⚠ WARNING ⚠

Always use suitable tools to align holes. DO NOT USE HAND OR FINGERS. Failure to comply could result in death or serious injury.

B020A

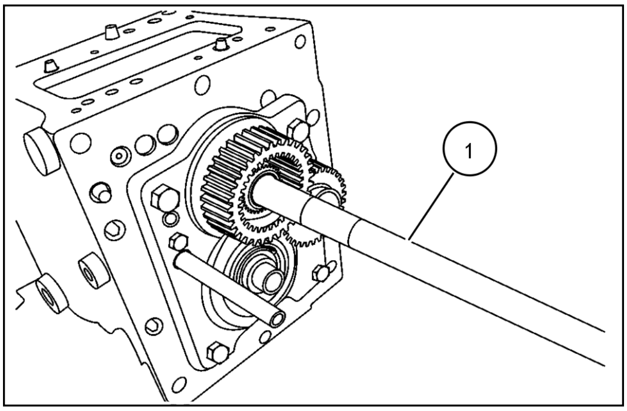
⚠ WARNING ⚠

Lift and handle all heavy components using lifting equipment of appropriate lifting capacity. Ensure that units or parts are supported by suitable slings or hooks. Ensure that no persons or pets are in the vicinity of the load to be lifted. Failure to comply could result in death or serious injury.

M1258

To remove the Intermediate plate and reverse gear.

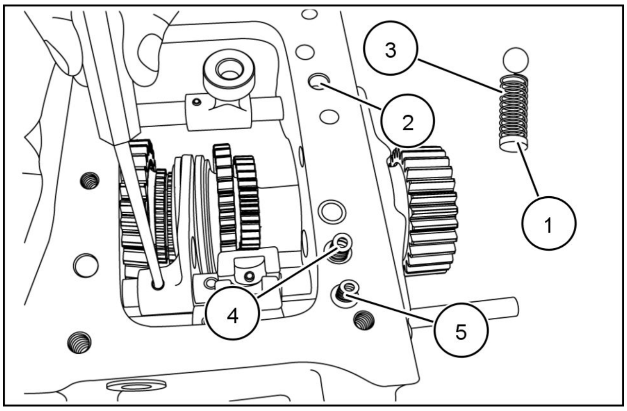
1. Remove PTO shaft, **(1)**.



200900180 1

2. Remove all roll pins from gear rails to make dismantling easy , also remove the springs and balls

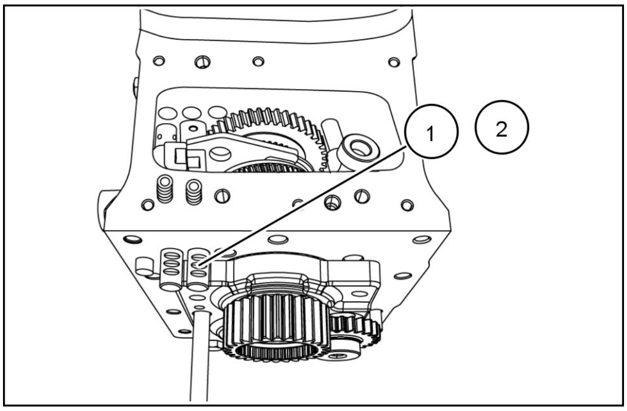
NOTE: *Remove plug,* ***(1)****, from housing as shown at* ***(2)****, from where Hi/Low rail passes, retrieve spring and ball,* ***(3)*** *of Hi/Low rail. Retrieve balls and springs from location* ***(4)*** *and* ***(5)****.*



20099991 2

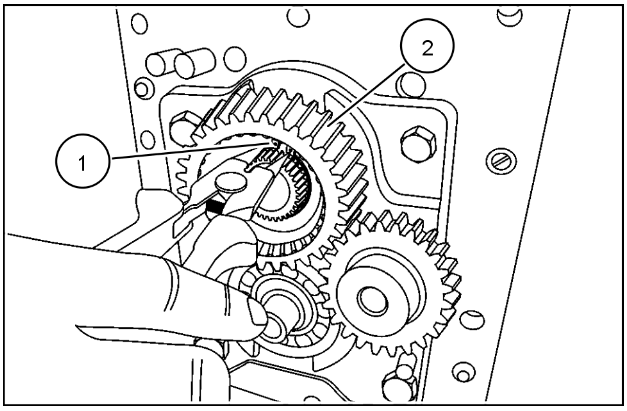
3. Remove the springs, **(1)** and balls, **(2)**, with the help of a magnetic tool.
4. Remove all the rails and take out gates, forks.

NOTE: *Bring all the gears neutral position to remove rails and retrieve balls from crown side.*



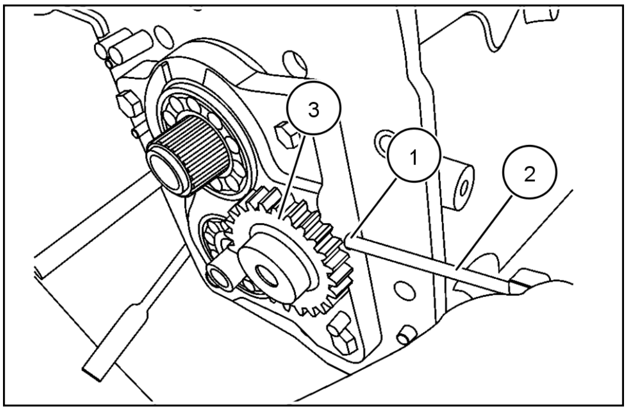
20099989 3

5. Remove the snap ring, **(1)**, securing the reverse drive gear.
6. Remove the reverse drive gear, **(2)**, from drive shaft.



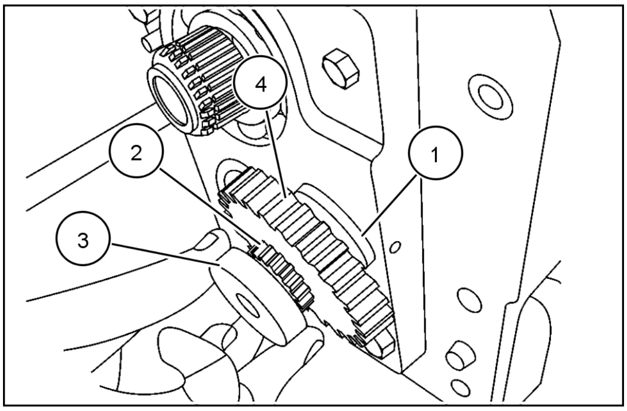
200900258 4

7. Unscrew the reverse intermediate gear shaft locking screw, **(1)**, with a screw driver, **(2)**.
8. Remove the idler gear, **(3)**.



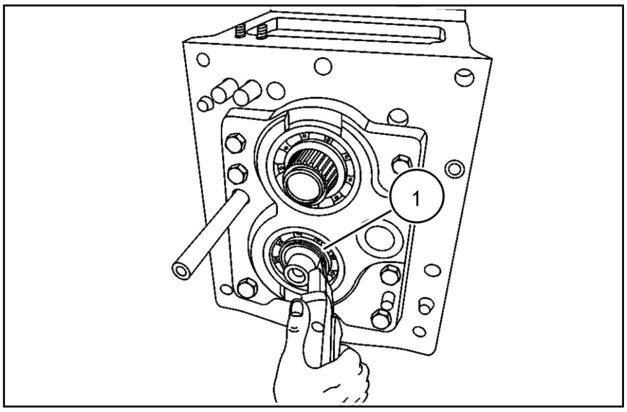
200900202 5

9. Remove the, spacer, **(1)**, needle bearing, **(2)**, and reverse intermediate gear pin, **(3)**, along with reverse intermediate gear, **(4)**.



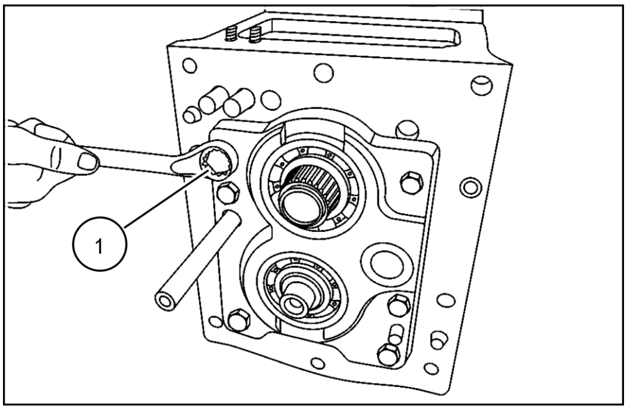
200900201 6

10. Remove the snap ring, **(1)**, securing the driven shaft bearing.



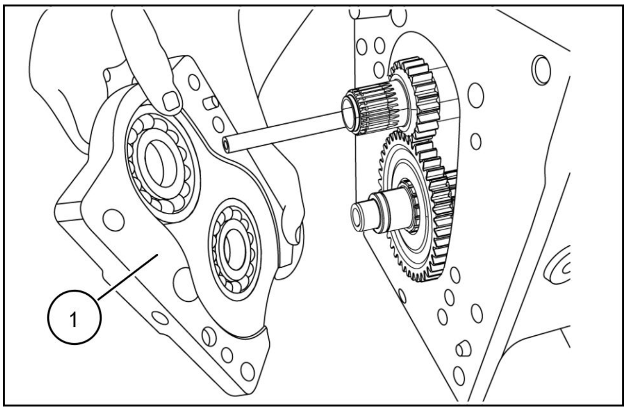
200900203 7

11. Remove all the bolts, **(1)**, securing the intermediate plate.



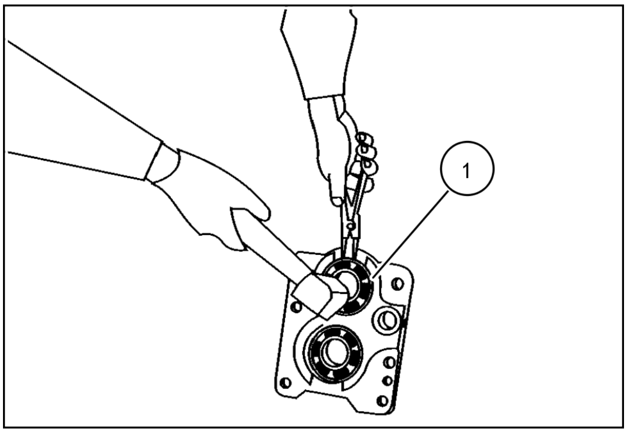
200900200 8

12. Remove the intermediate plate, **(1)**, along with the bearings.



200900199 9

13. Remove the ball bearings from the intermediate plate by expanding the retaining rings, **(1)**.



20097850 10

Next operation:
TRANSMISSION Mechanical - Inspect Intermediate plate (C.20.B)

TRANSMISSION Mechanical - Inspect Intermediate plate

Prior operation:
TRANSMISSION Mechanical - Disassemble Intermediate plate (C.20.B)

1. Clean and inspect the shift fork, shift rail, coupler, hub, bearings, and gears for excessive wear and/or damage. Replace as needed.

Next operation:
Shaft - Remove Transmission Driven and Drive Shaft (C.20.B)

TRANSMISSION Mechanical - Assemble Intermediate plate

Prior operation:
Shaft - Install Transmission Driven and Drive Shaft (C.20.B)

⚠ WARNING ⚠

Always use suitable tools to align holes. DO NOT USE HAND OR FINGERS. Failure to comply could result in death or serious injury.

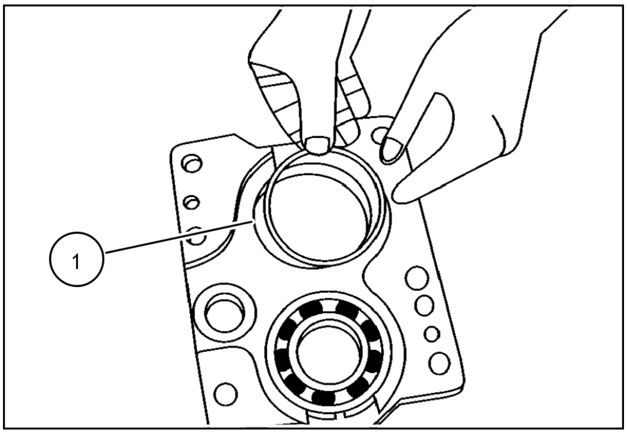
B020A

⚠ WARNING ⚠

Handle all parts carefully. Do not put your hands or fingers between parts. Always wear suitable safety items such as fitted clothing, safety goggles, gloves, shoes, etc. Failure to comply could result in death or serious injury.

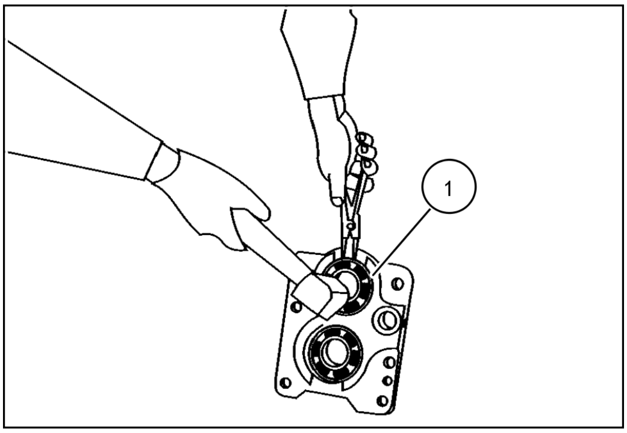
M954A

1. Install the retaining rings, **(1)**, into the intermediate plate.



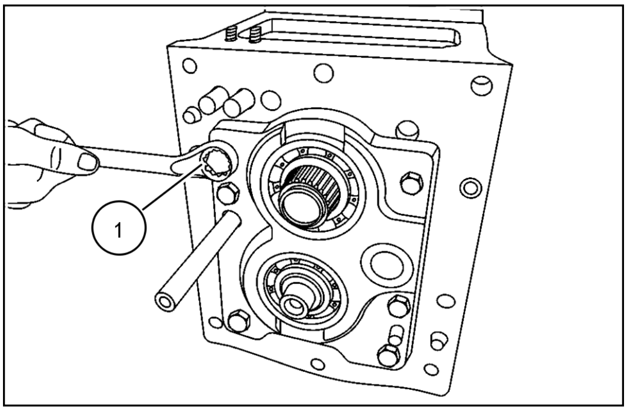
20097851 1

2. Expand the retaining ring, **(1)** and insert the bearing. Use a hammer to drive the bearing in until the retaining ring locks into the groove on the bearing.
3. Install the intermediate plate on the front of the transmission housing.



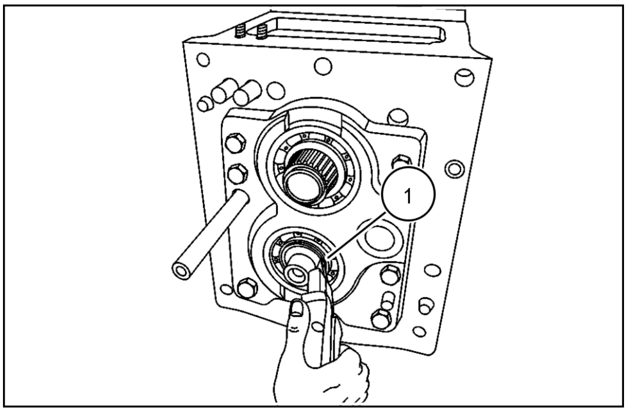
20097850 2

4. Secure the intermediate plate with the bolts, **(1)**, that were removed during disassembly.



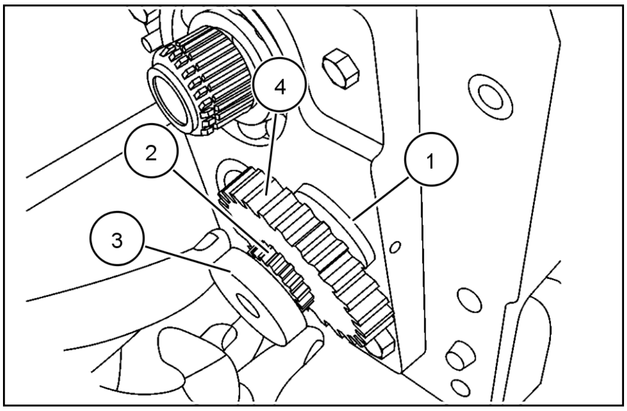
200900200 3

5. Secure the driven shaft bearing with the snap ring, **(1)**.



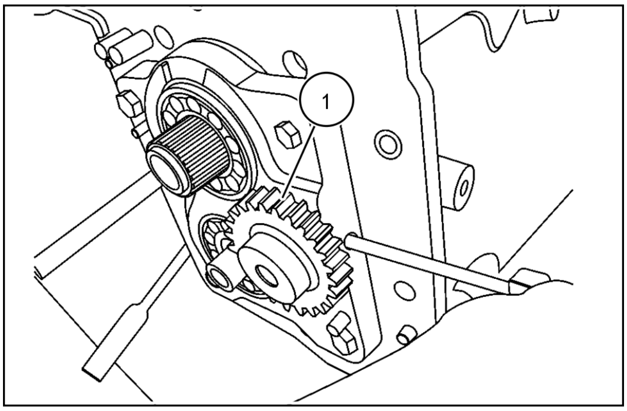
200900203 4

6. Install, the spacer, **(1)**, needle bearing, **(2)** and reverse intermediate gear pin, **(3)**, along with the reverse intermediate gear, **(4)**.



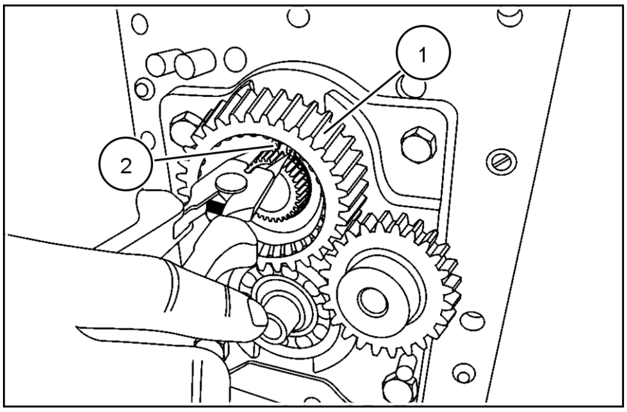
200900201 5

7. Use thread locker 243 for locking reverse intermediate gear, **(1)**, shaft screw.



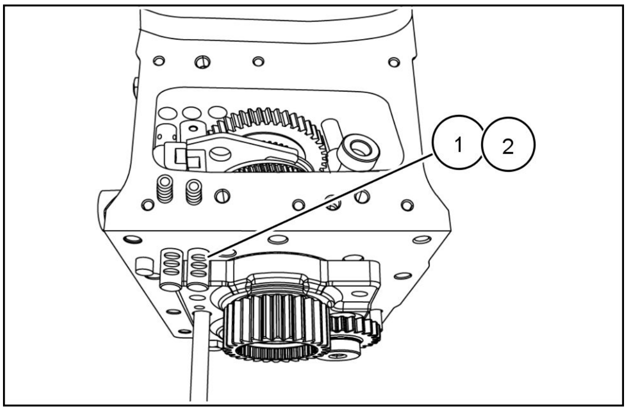
200900202 6

8. Install the reverse drive gear, **(1)**, onto the drive shaft.
9. Secure the reverse drive gear, **(1)**, with the snap ring, **(2)**.



200900258 7

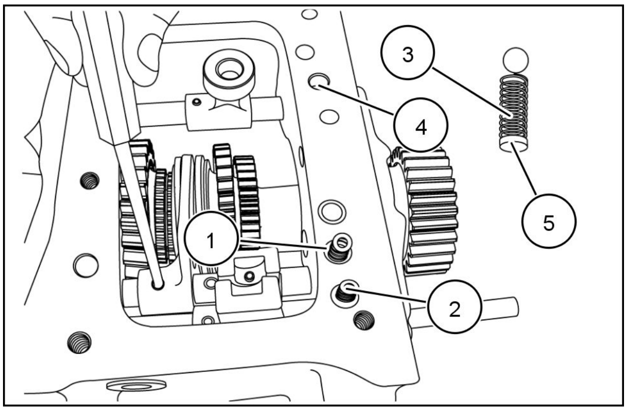
10. Install all the shift rails, shift gates, and shift forks after installing the springs, **(1)** and detent balls, **(2)**.



20099989 8

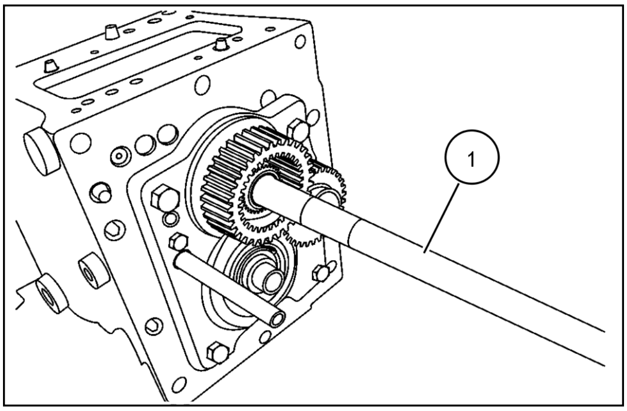
11. Install all roll pins to shift rails, along with springs and detent balls.

NOTE: *Install the detent balls and springs where shown,* ***(1)****, and* ***(2)****. Insert the Hi/Low rail detent ball and spring ,* ***(3)****, where shown,* ***(4)****. Install the plug,* ***(5)****, above the Hi/Low rail detent ball and spring at,* ***(4)****.*



20099991 9

12. Install the PTO shaft, **(1)**.



200900180 10

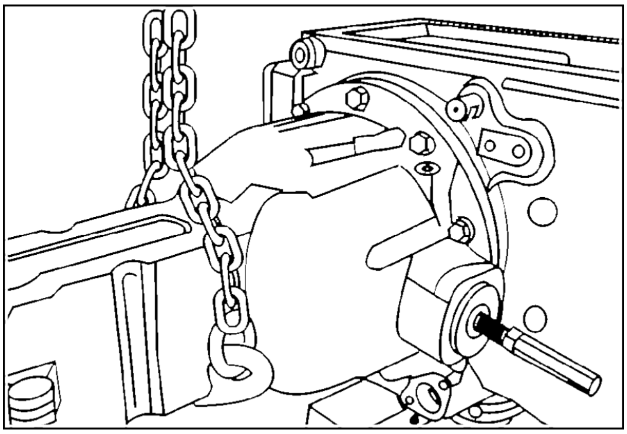
Next operation:
TRANSMISSION Mechanical - Install Transmission assembly (C.20.B)

TRANSMISSION Mechanical - Install Transmission assembly

Prior operation:
TRANSMISSION Mechanical - Assemble Intermediate plate (C.20.B)

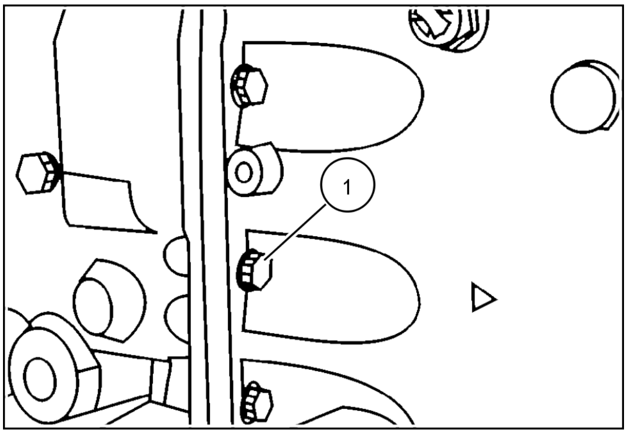
NOTE: *Before assembling housings, covers and support, thoroughly clean and degrease mating surfaces and apply a **2 mm** (**0.1 in**), bead of **LOCTITE 518** sealant as shown in Figure **18**.*

1. Use a suitable lifting device to lift and install the final drive housing.
2. Install the final drive housing onto the transmission housing. Secure the final drive housing with the bolts from removal. Torque the M12 bolts to **98 N·m** (**72 lb ft**).
3. Repeat procedure for other side.



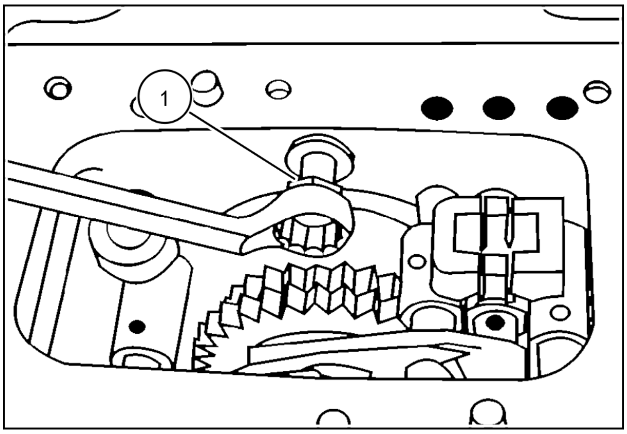
20097830 1

4. Using a suitable lifting device, install the hydraulic housing onto the rear of the transmission housing.
5. Remove the complete transmission assembly from the stand using a suitable device.
6. Attach the transmission housing to the clutch housing and secure with the M12 attaching bolts, **(1)**, from removal.Torque the bolts to **88 N·m** (**65 lb ft**).



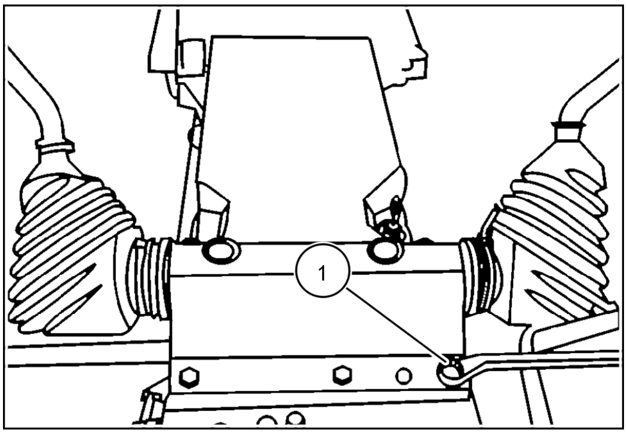
20097826 2

7. Attach the Clutch housing to the Transmission housing by installing the bolt, **(1)**.



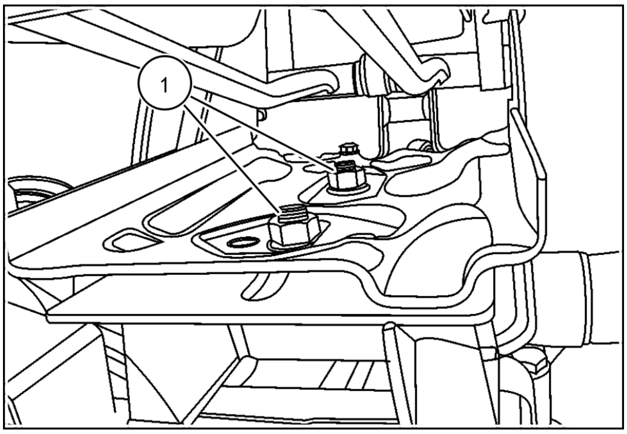
20097828 3

8. Install the M8 X 20 gear box cover bolts, **(1)**, securing cover. Torque the bolts to **24.5 N·m** (**18 lb ft**).



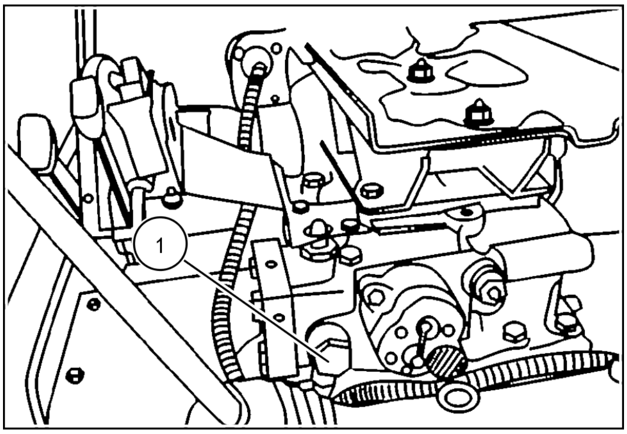
20097827 4

9. Install the operator's seat onto the hydraulic housing and secure with hardware, **(1)**, from removal.



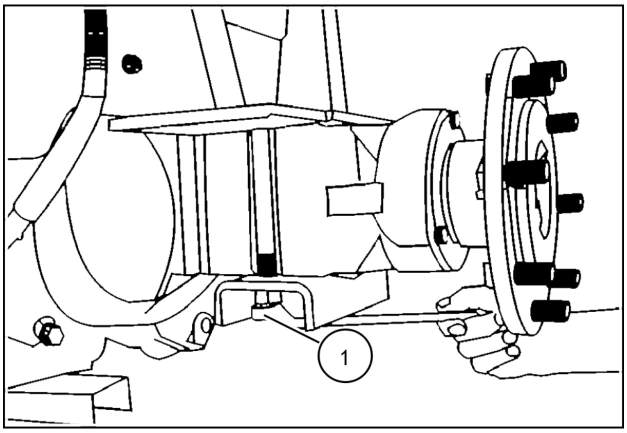
20097825 5

10. Connect the hydraulic lines, **(1)**, connecting pump and hydraulic distributor.



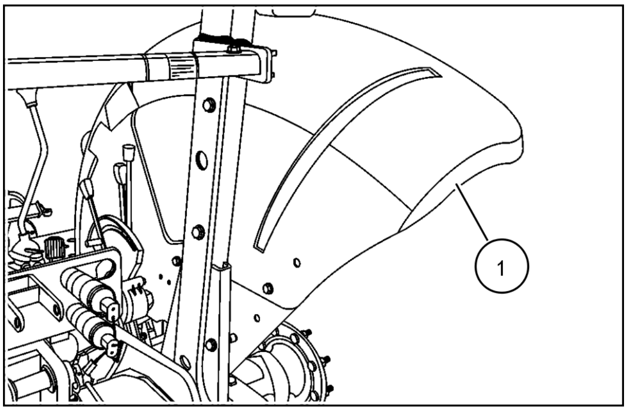
20097822 6

11. Install the rops to the axle housings. Secure using the bolts and nuts, **(1)**. Refer to: **ROPS - Install ROLL - OVER PROTECTION BAR (E.34.A)**



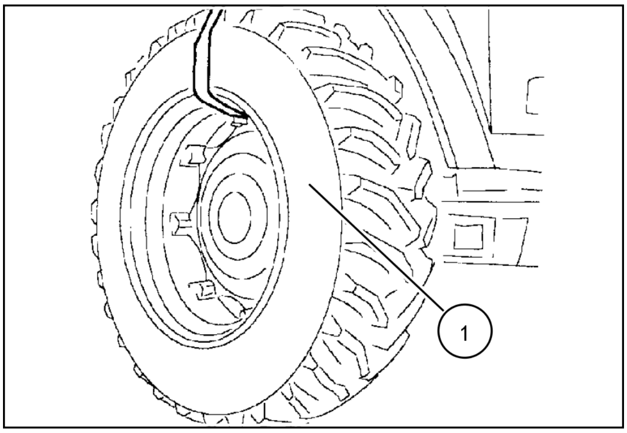
20097821 7

12. Install the rear fenders, **(1)**. Refer to: **Protective shield - Install REAR WHEEL FENDERS (E.20.A)**



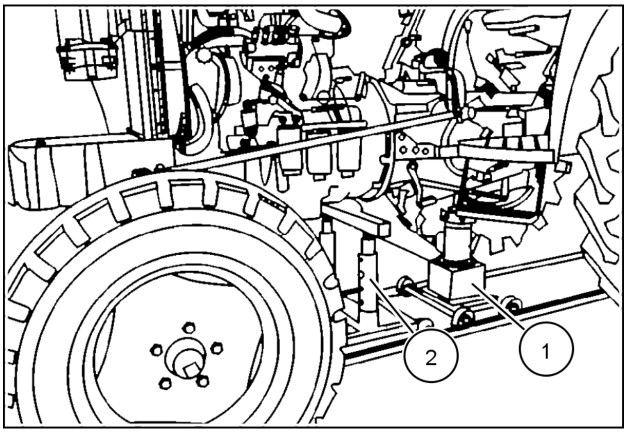
20099840 8

13. Install both left-hand and right-hand side wheels, **(1)**.



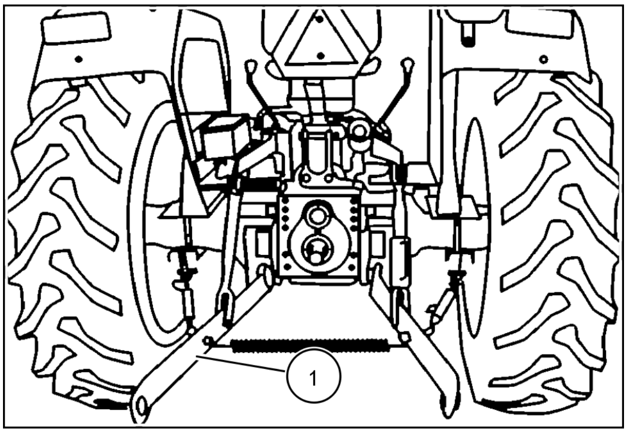
20096210 9

14. Remove the jack stands, **(1)**, and splitting trolley, **(2)**.



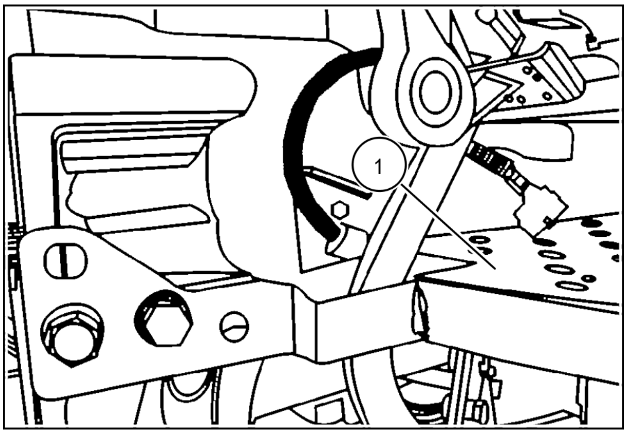
20097824 10

15. Install the three point linkages, **(1)**, to the tractor.



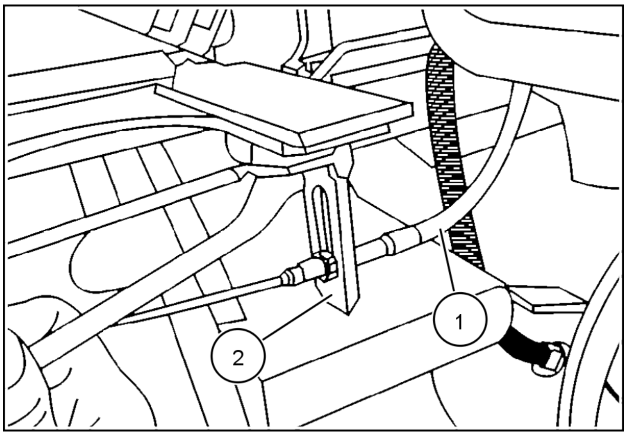
20097823 11

16. Secure the footrest, **(1)**, to the fender and transmission housing.



20097820 12

17. Connect the foot throttle linkage, **(1)**, to the bracket, **(2)**.

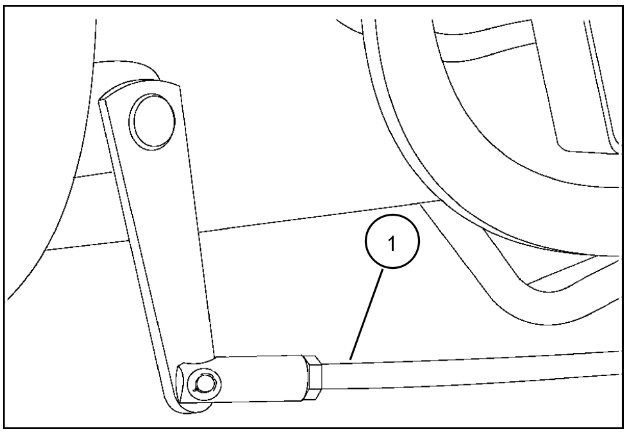


20097808 13

18. Connect the clutch linkage, **(1)**.

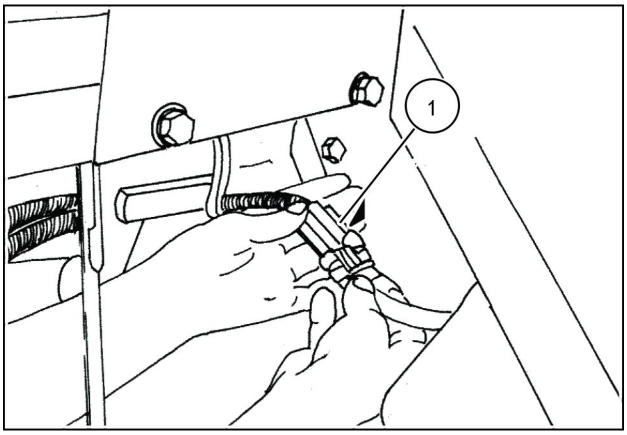
NOTE: *Check the clutch pedal free play and adjust as necessary. Refer to:* ***Command - Adjust Clutch pedal setting (C.10.C)***

NOTE: *Connect the brake linkage rods to the brake pedals. Refer to:* ***Command - Install Brake pedals and external linkages (D.30.B)***



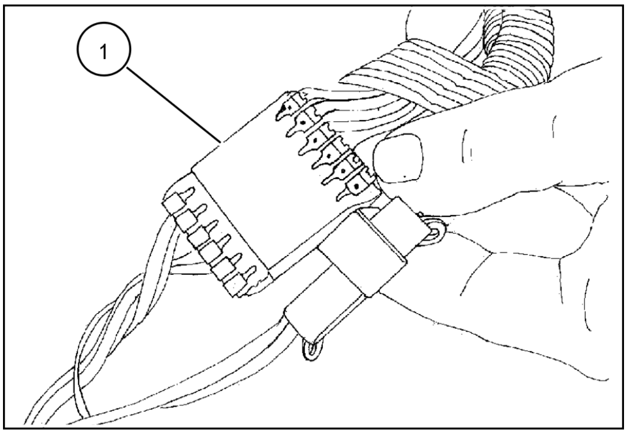
20097509 14

19. Connect the wire harness connector, **(1)**, between left-hand and right-hand side fenders.



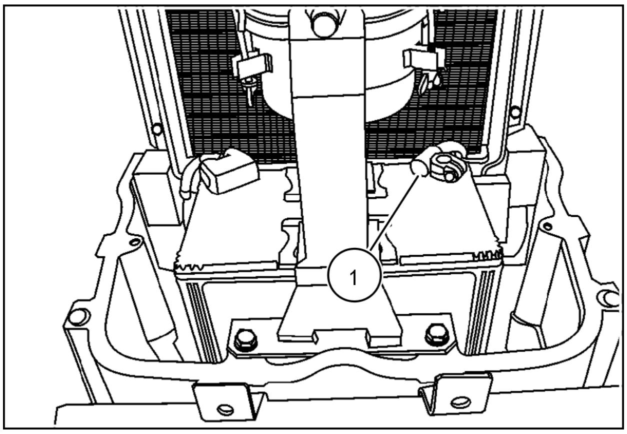
20093437 15

20. Connect the rear wire harness connector, **(1)**, to the front wire harness connector, located under the steering column side panels.

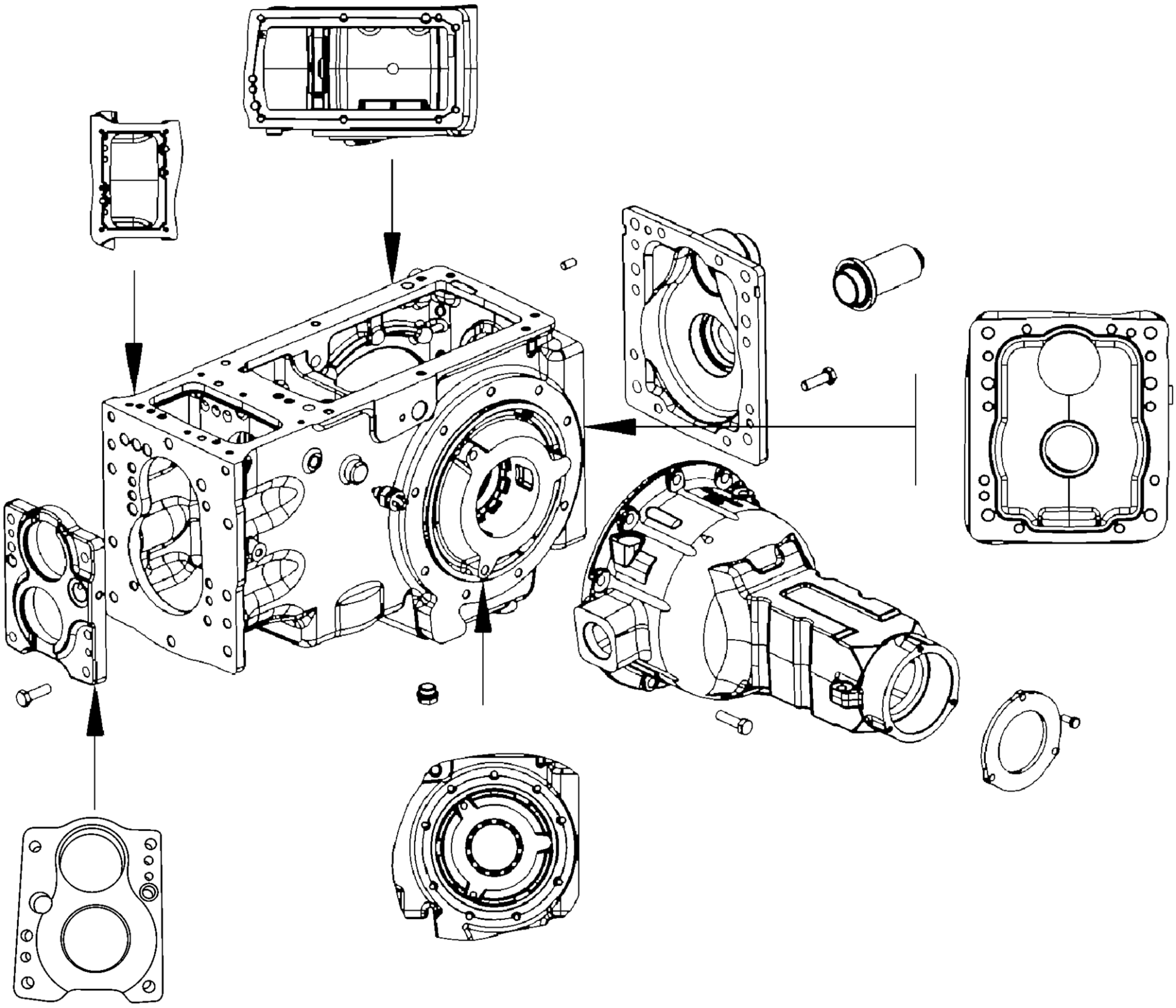


20097819 16

21. Connect the negative battery cable, **(1)**, to the negative battery terminal.



20097818 17



200900173 18

Transmission command - Remove Gear Shift Lever

Prior operation:
TRANSMISSION Mechanical - Remove Transmission assembly (C.20.B)

⚠ WARNING ⚠

Always use suitable tools to align holes. DO NOT USE HAND OR FINGERS. Failure to comply could result in death or serious injury.

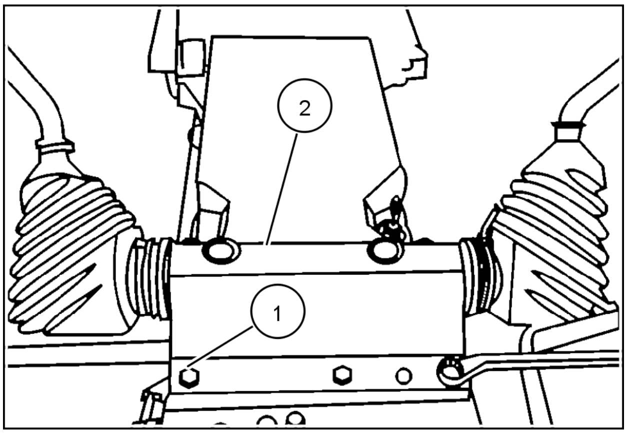
B020A

⚠ WARNING ⚠

Handle all parts carefully. Do not put your hands or fingers between parts. Always wear suitable safety items such as fitted clothing, safety goggles, gloves, shoes, etc. Failure to comply could result in death or serious injury.

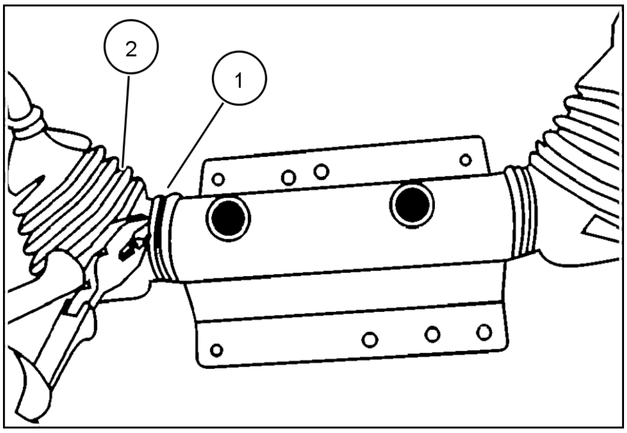
M954A

1. Loosen the bolts, **(1)** and remove the top cover, **(2)**, from the transmission housing.



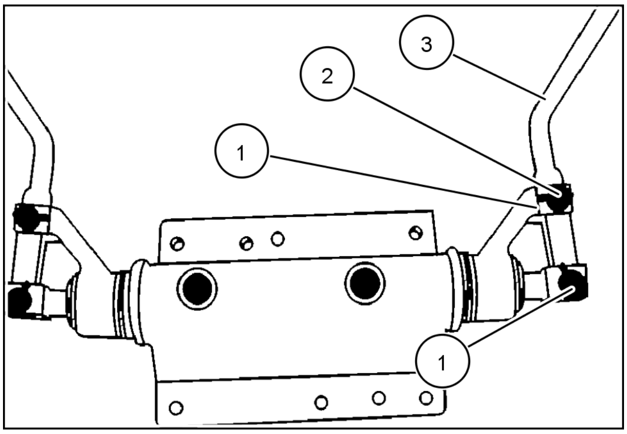
20097827 1

2. Remove the cable tie/strap, **(1)**, to remove the gear lever rubber boot, **(2)**.



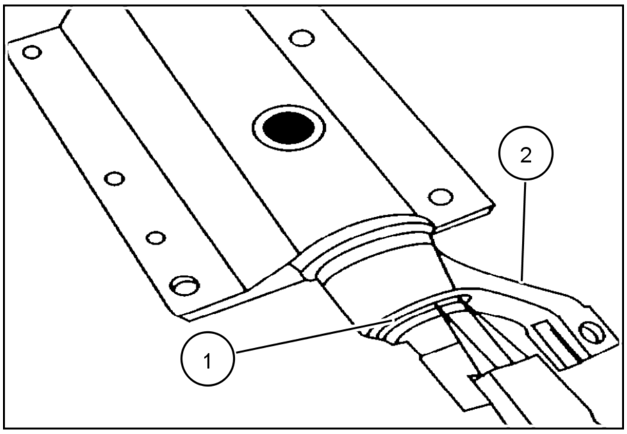
20097888 2

3. Remove the split pins, **(1)** and take out the pin, **(2)**, to remove the lever, **(3)**, from left-hand and right-hand side.



20097889 3

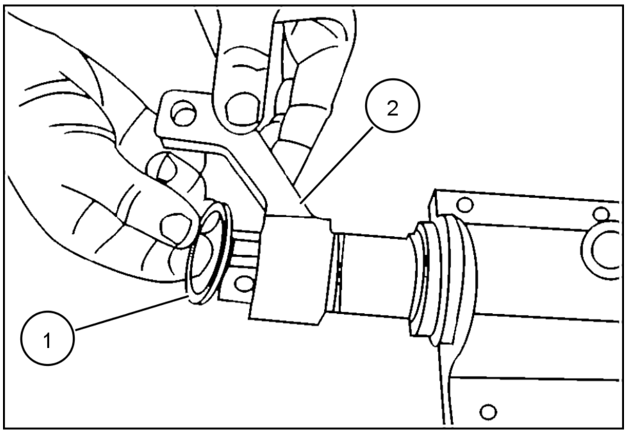
4. Remove the circlip lock, **(1)**, from the yoke **(2)**, from left-hand and right-hand gear shift levers.



20097890 4

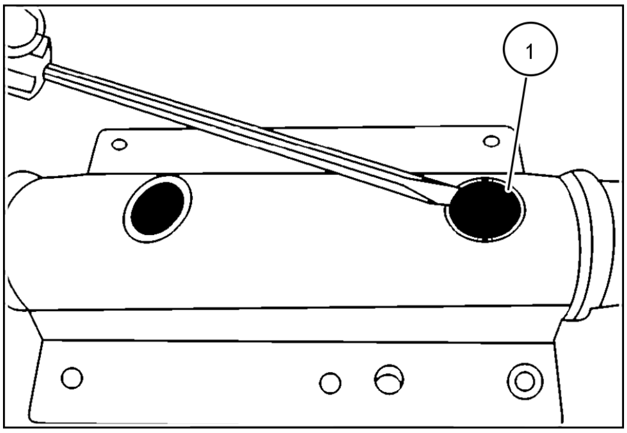
5. Remove the washer, **(1)** and the yoke, **(2)**, from left-hand and right-hand gear shift levers.

NOTE: *Take out springs from the range lever.*



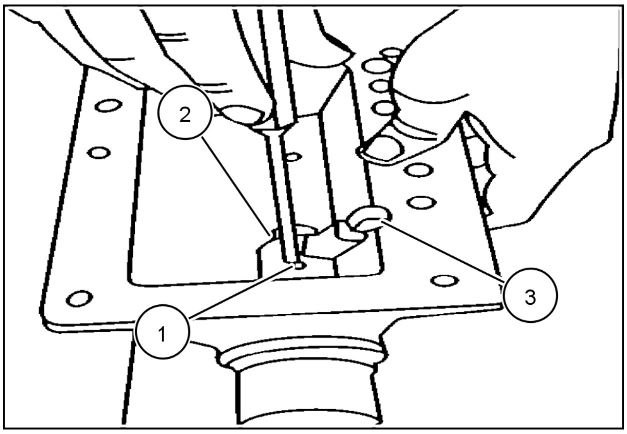
20097891 5

6. Remove the expansion plug, **(1)**, from the shifter cover housing.



20097892 6

7. Remove the roll pin, **(1)**, from the shaft, **(2)** and remove the fork, **(3)**.



20097893 7

Next operation:
Transmission command - Install Gear Shift Lever (C.20.B)

Transmission command - Install Gear Shift Lever

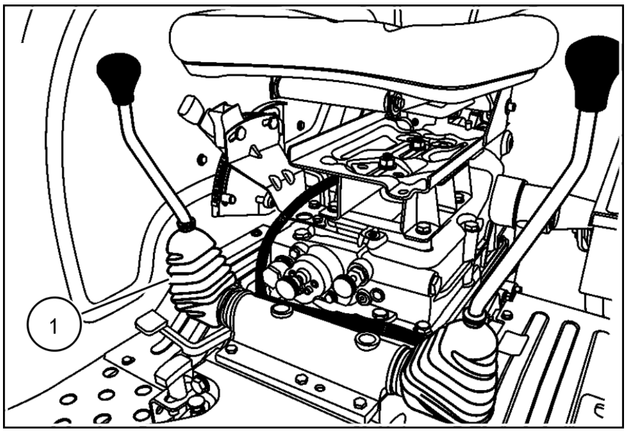
Prior operation:
Transmission command - Remove Gear Shift Lever (C.20.B)

⚠ **WARNING** ⚠

Always use suitable tools to align holes. DO NOT USE HAND OR FINGERS. Failure to comply could result in death or serious injury.

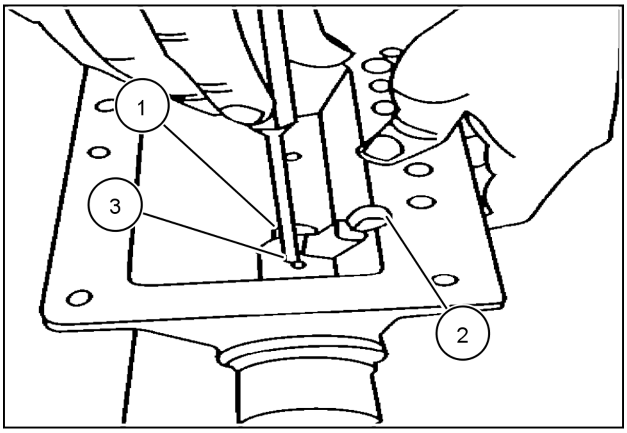
B020A

1. Assemble the levers in the cover plate and reinstall the cover plate on the transmission housing observing the following:
   - Inspect the rubber boot, **(1)**, for cracks or damage, replace if necessary.



20097815 1

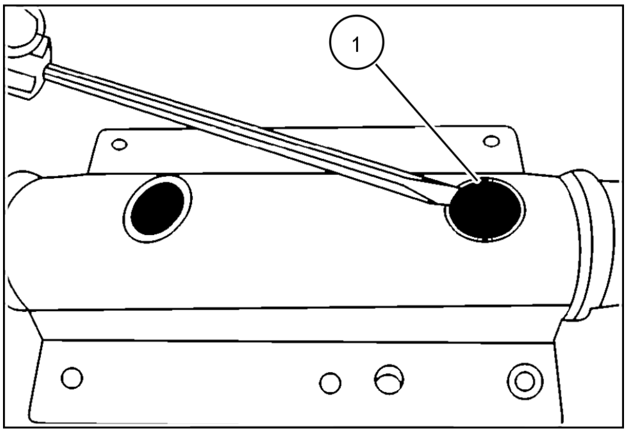
2. Install the shaft, **(1)**, fork, **(2)** and roll pin, **(3)**.



20097893 2

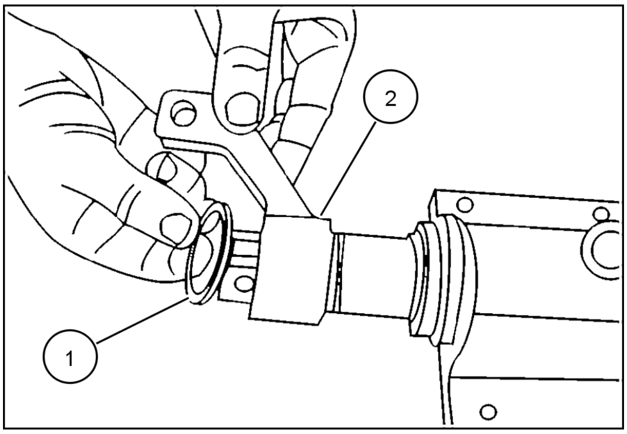
NOTE: *Use sealant on expansion plug holes before fitting expansion plugs to avoid possible oil leakage from plugs*

3. Assemble the expansion plug, **(1)**, to the shifter cover housing.



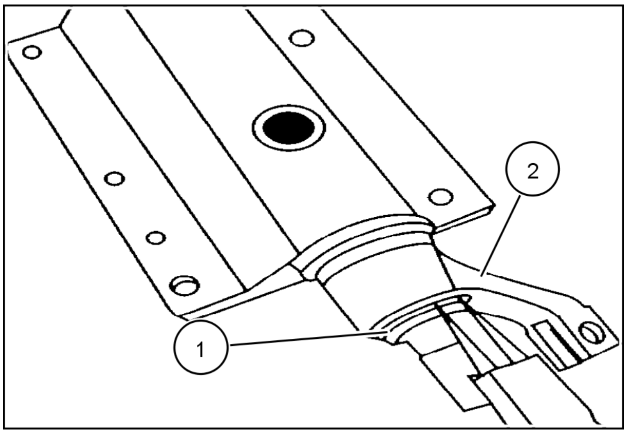
20097892 3

4. Use a suitable tool (not shown) to install the springs to the range lever
5. Install the washer, **(1)** and the yoke, **(2)**, to left-hand and right-hand gear shift levers.



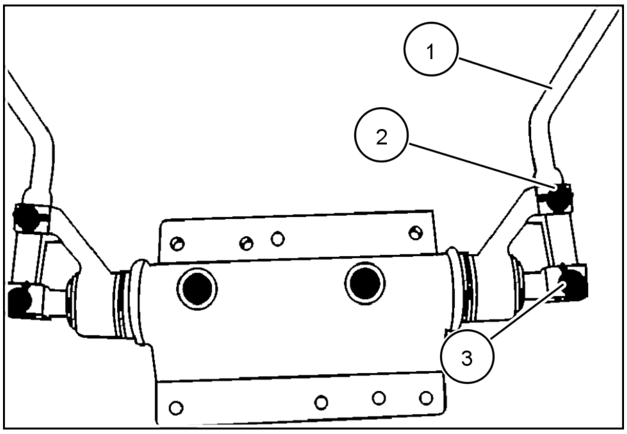
20097891 4

6. Install the circlip lock, **(1)**, to the yoke, **(2)**, in left-hand and right-hand gear shift levers.



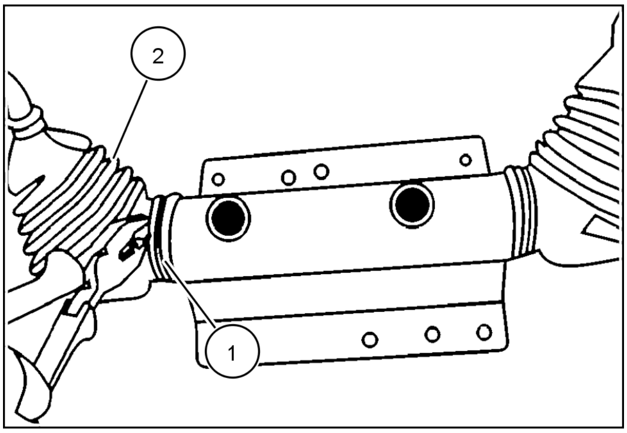
20097890 5

7. Install the lever, **(1)**, to left-hand and right-hand side.
8. Assemble the pin, **(2)**, and install split pins, **(3)**.



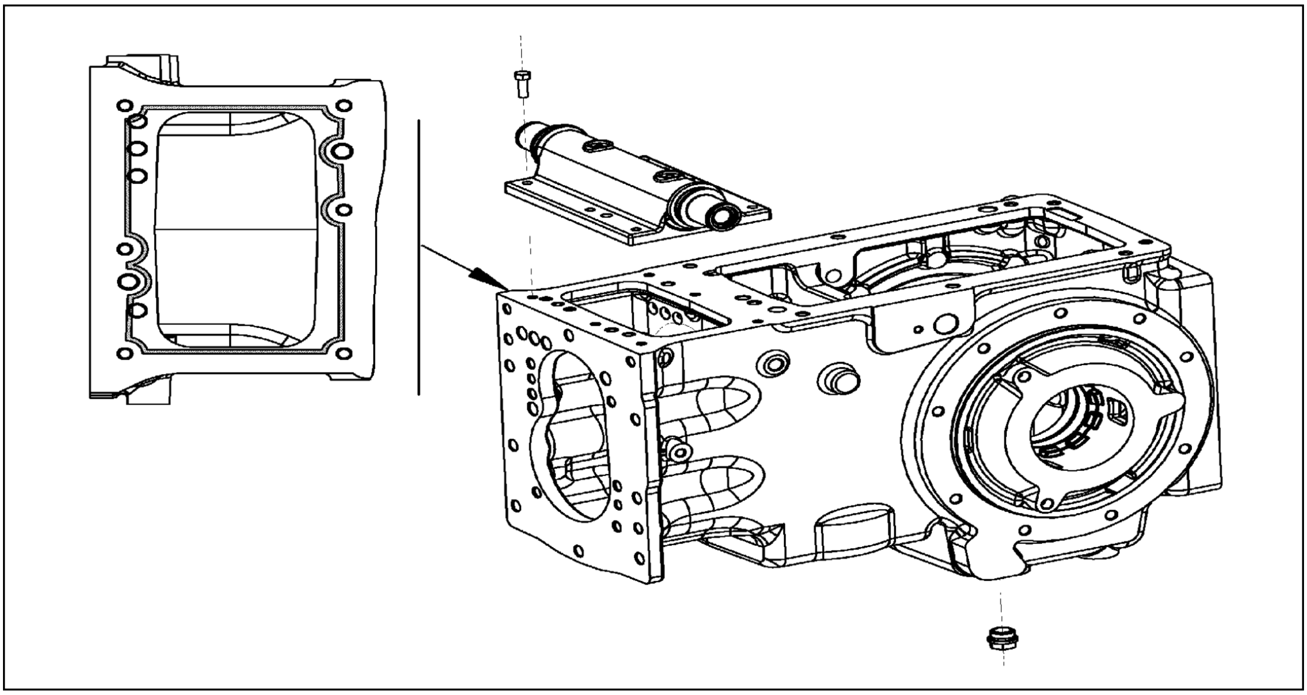
20097889 6

9. Install the circlip, **(1)** and install the rubber boot, **(2)**.



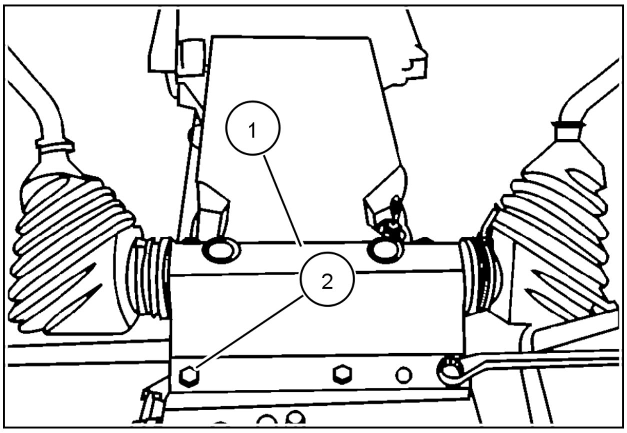
20097888 7

10. Before installing the cover plate, thoroughly clean and degrease the mating surfaces. Apply a **2 mm** (**0.08 in**) bead of **LOCTITE® 518** sealant following the pattern shown in Figure **8**.



20097895 8

11. Install the top cover, **(1)**, onto the transmission housing and secure with the M8 bolts, **(2)**, from removal. Torque the bolts to **24.5 N·m** (**18 lb ft**).



20097827 9

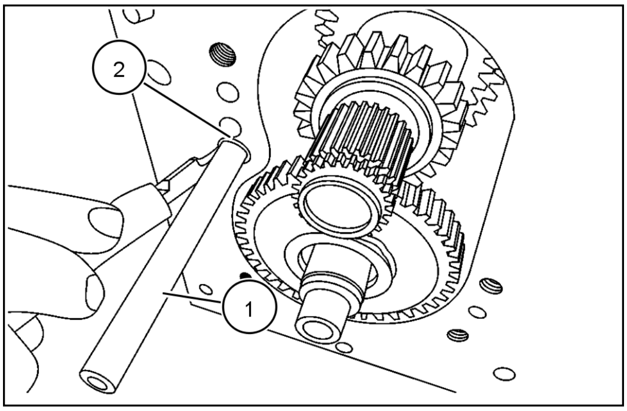
Shaft - Remove Transmission Driven and Drive Shaft

Prior operation:
TRANSMISSION Mechanical - Inspect Intermediate plate (C.20.B)

Driven shaft removal

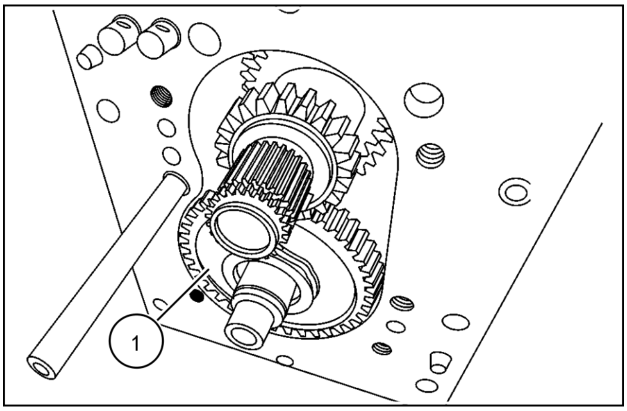
1. Remove the bottom shift rail, **(1)**.

NOTE: *The bottom shift rail has a M12 plug,* ***(2)****. That must be removed from the front of the housing.*



200900197 1

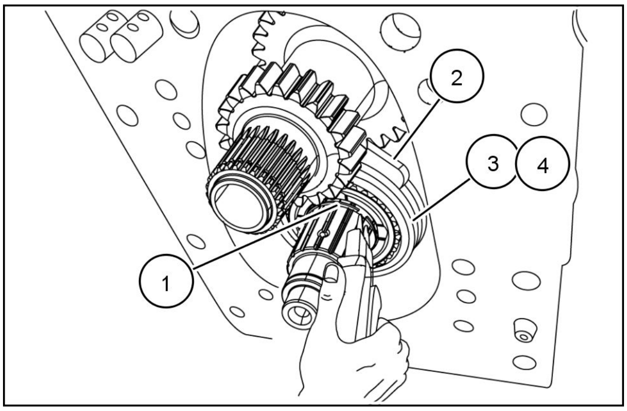
2. Remove 1st gear, **(1)**, off the driven shaft.



200900198 2

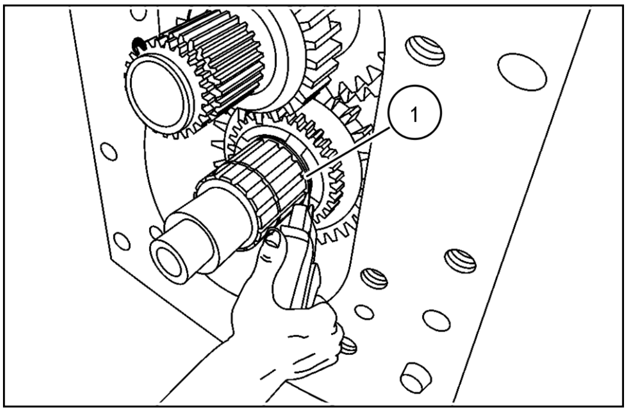
3. Remove the snap ring, **(1)**, from the driven shaft and take out the 1st/2nd gear shift fork, **(2)**, the 1st/2nd gear coupler, **(3)**, the hub, **(4)**, off the driven shaft.

NOTE: *Keep the face of the hub with the cut towards the pinion side.*



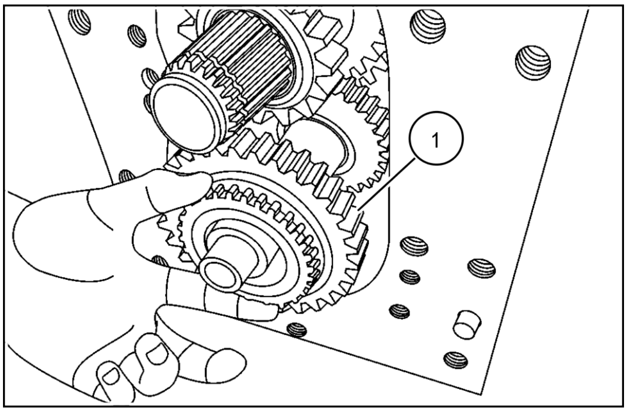
200900196 3

4. Remove the snap ring, **(1)**, securing the 2nd gear.



200900195 4

5. Remove the 2nd gear, **(1)**, from driven shaft.

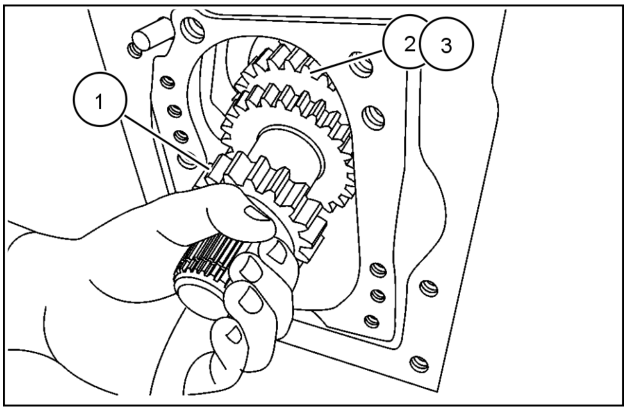


200900194 5

Drive shaft removal

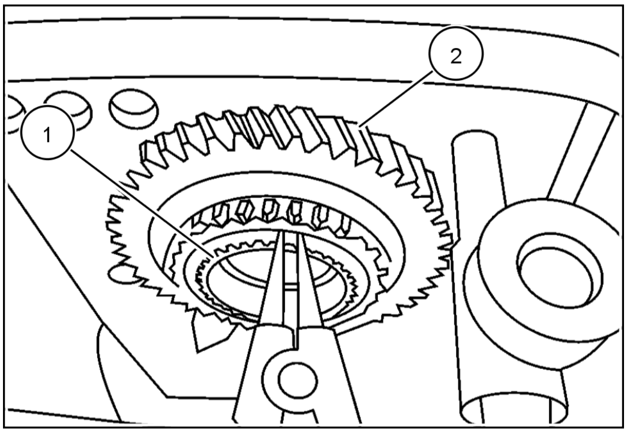
6. Remove the drive shaft, **(1)**, 3rd gear drive gear, **(2)**, and 3rd/4th gear coupler, **(3)**, as a assembly from the transmission housing.

NOTE: *1st and 2nd gear are a integral part of the drive shaft.*



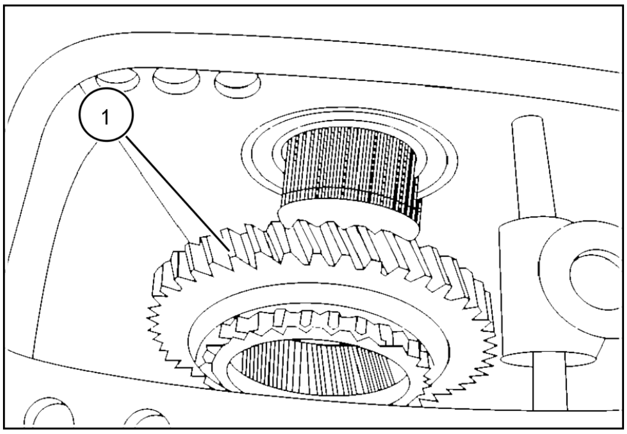
200900193 6

7. Remove the snap ring, **(1)**, securing the 4th gear drive gear, **(2)**, on the range shaft.



20097858 7

8. Remove the 4th gear drive gear, **(1)**, from the range shaft.

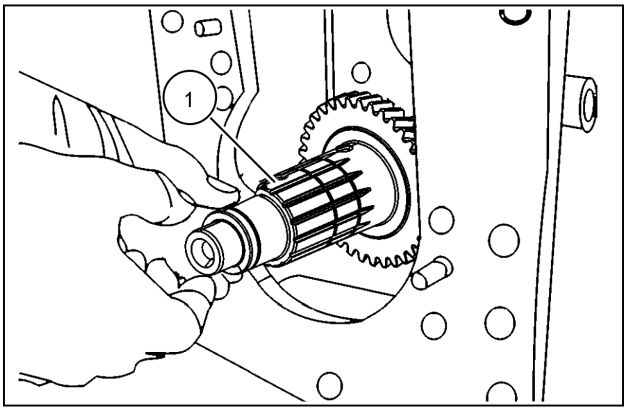


20097859 8

9. Remove the driven shaft, **(1)**, from the housing.

NOTE: *3rd and 4th gears are a integral part of the driven shaft.*

10. Clean and inspect the gears and hub for excess wear, chipped gear teeth, cracks or any other damage. Replace as necessary.
11. Inspect the shift fork for wear or damage. Replace as necessary.
12. Inspect the shift rail for wear or damage. Replace as necessary.



200900208 9

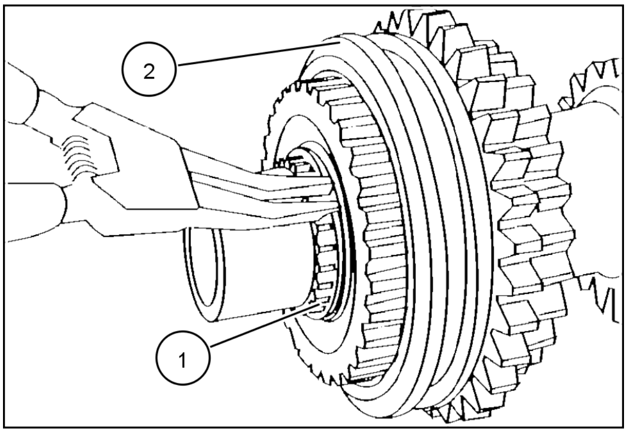
Next operation:
Shaft - Disassemble Transmission Drive Shaft (C.20.B)

Shaft - Disassemble Transmission Drive Shaft

Prior operation:
Shaft - Remove Transmission Driven and Drive Shaft (C.20.B)

Dismantling on bench

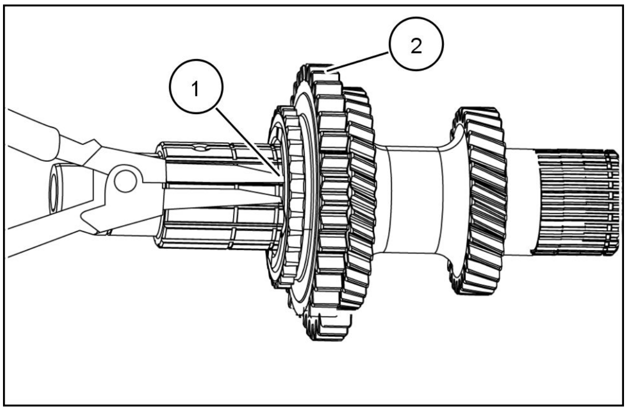
1. Remove the snap ring, **(1)**, from the drive shaft to remove the hub and 3rd/4th gear coupler, **(2)**.



20097861 1

2. Remove the snap ring, **(1)**, from the drive shaft before removing the 3rd gear drive gear, **(2)**.

NOTE: *1st and 2nd gear are a integral part of the drive shaft*



200900207 2

Next operation:
Shaft - Inspect Transmission Drive Shaft (C.20.B)

Shaft - Inspect Transmission Drive Shaft

Prior operation:
Shaft - Disassemble Transmission Drive Shaft (C.20.B)

1. Wash all parts in a suitable cleaning solution and allow to air dry.
2. Inspect all gears for excess wear, chipped gear teeth, cracks or any other damage. Replace as necessary.
3. Inspect the gear coupler and drive shaft for any cracks or damage. Replace as necessary.

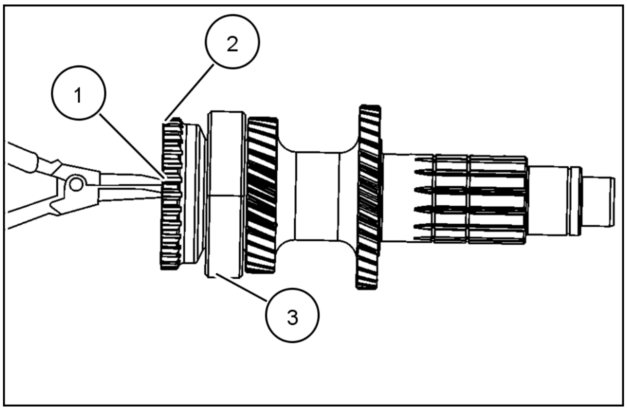
Next operation:
Shaft - Disassemble Transmission Driven Shaft (C.20.B)

Shaft - Disassemble Transmission Driven Shaft

Prior operation:
Shaft - Remove Transmission Driven and Drive Shaft (C.20.B)

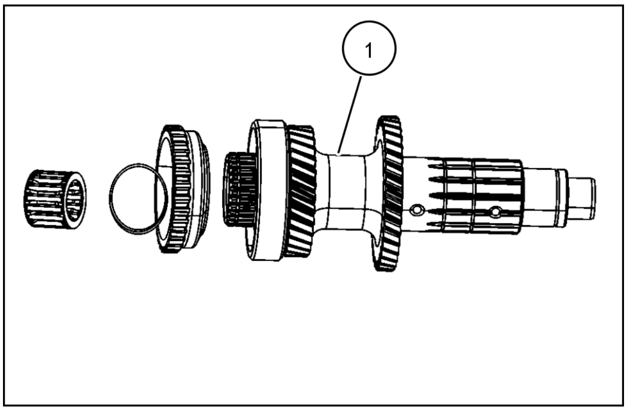
DISMANTLING ON BENCH

1. Remove the snap ring, **(1)**, to remove the high gear, **(2)**, and bearing, **(3)**, from the driven shaft



200900206 1

NOTE: *3rd and 4th gear are a integral part of the driven shaft,* ***(1)****.*



200900204 2

Next operation:
Shaft - Inspect Transmission Driven Shaft (C.20.B)

Shaft - Inspect Transmission Driven Shaft

Prior operation:
Shaft - Disassemble Transmission Driven Shaft (C.20.B)

1. Wash all parts in a suitable cleaning solution and allow to air dry.
2. Inspect the bearing for excess wear, score marks, discoloration from overheating or other damage. Rotate the bearing by hand and check for any roughness while turning. Replace as necessary.
3. Inspect all the gears and driven shaft for excess wear, chipped gear teeth, cracks or any other damage. Replace as necessary.

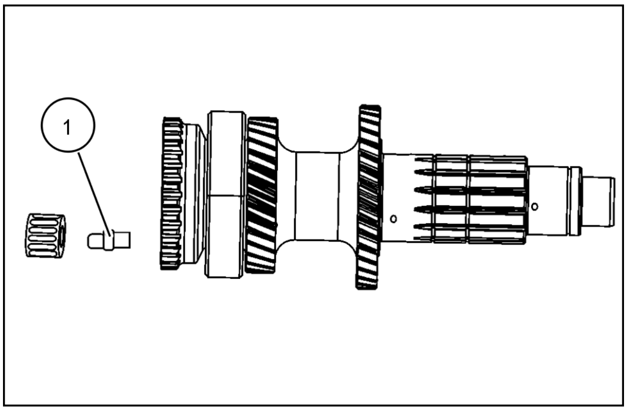
Next operation:
Shaft - Install Transmission Driven and Drive Shaft (C.20.B)

Shaft - Install Transmission Driven and Drive Shaft

Prior operation:
Shaft - Inspect Transmission Driven Shaft (C.20.B)

NOTE: *Before assembly carefully check gears, needle bearing, snap rings etc. and replace if found faulty.*

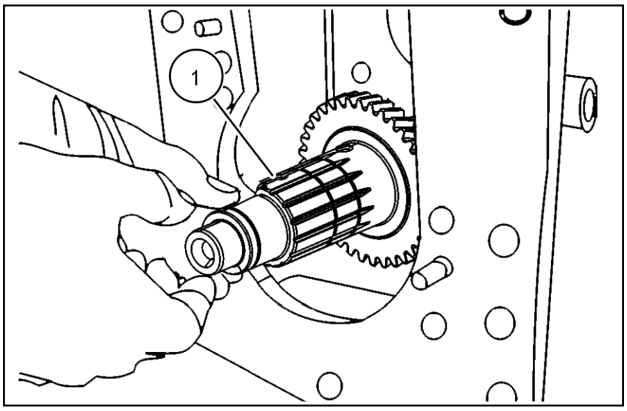
1. Fit the oil connector, **(1)**, between driven shaft and pinion keeping larger diameter towards driven shaft before fitting driven shaft on pinion.



200900205 1

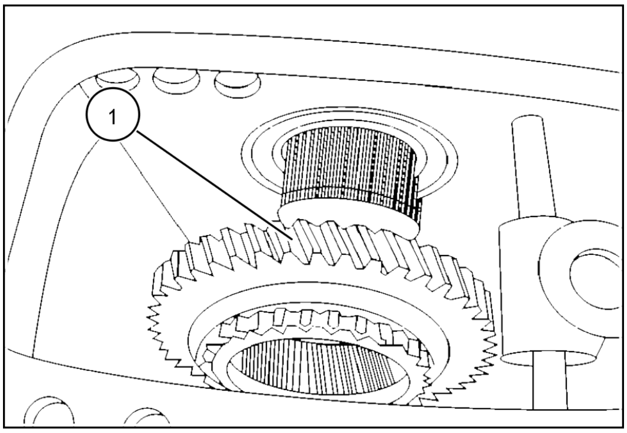
2. Install the driven shaft, **(1)**, into the housing.

NOTE: *3rd and 4th gears are a integral part of the driven shaft.*



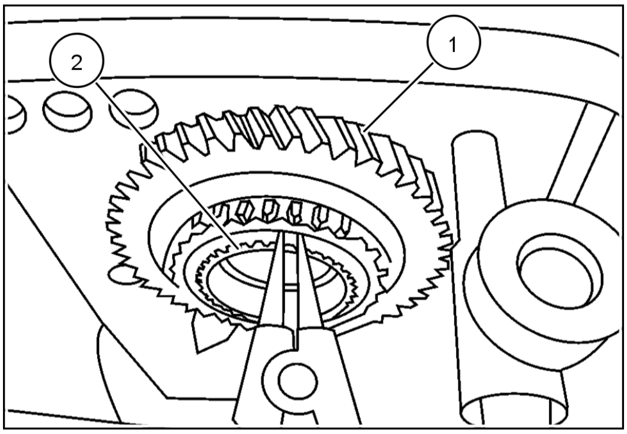
200900208 2

3. Install the 4th gear drive gear, **(1)**, onto the range shaft.



20097859 3

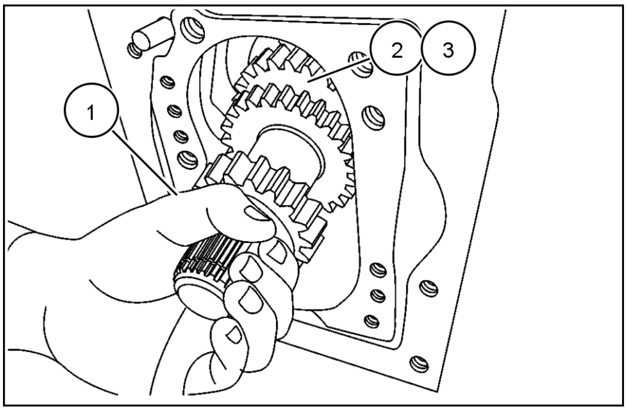
4. Secure the 4th gear drive gear, **(1)**, with the snap ring, **(2)**.



20097858 4

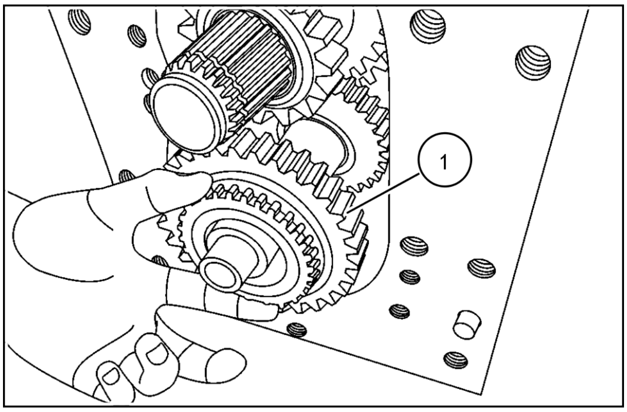
5. Install the drive shaft, **(1)**, in assembled form which includes the drive shaft, 3rd gear drive gear, **(2)** and 3rd / 4th gear coupler, **(3)**.

NOTE: *1st and 2nd gear are a integral part of the drive shaft.*



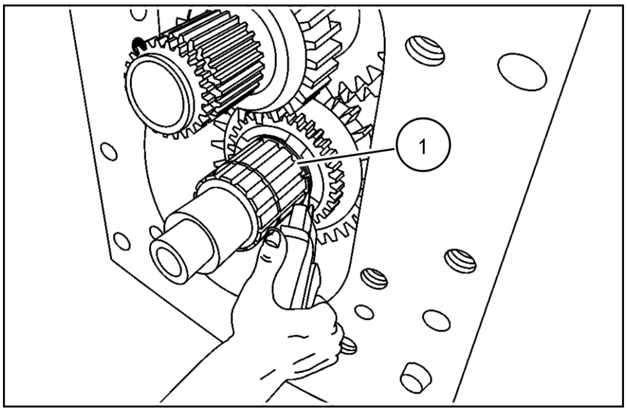
200900193 5

6. Install 2nd gear, **(1)**, onto the driven shaft.



200900194 6

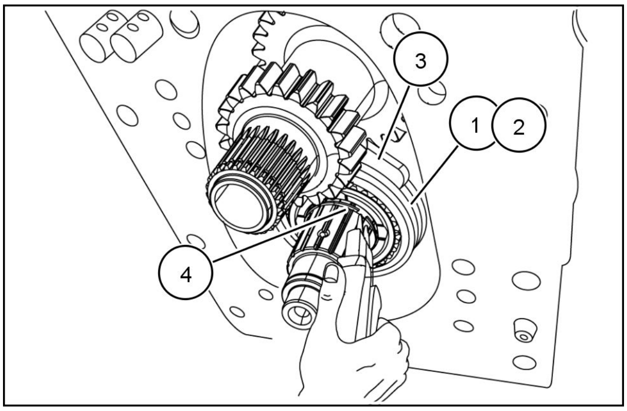
7. Secure 2nd gear with a snap ring, **(1)**.



200900195 7

8. Install the hub, **(1)**, 1st/2nd gear coupler, **(2)**, onto the driven shaft and insert the shift fork, **(3)**, onto the coupler. Secure the hub with the snap ring, **(4)**.

NOTE: *Keep the face of the hub with the cut towards the pinion side.*

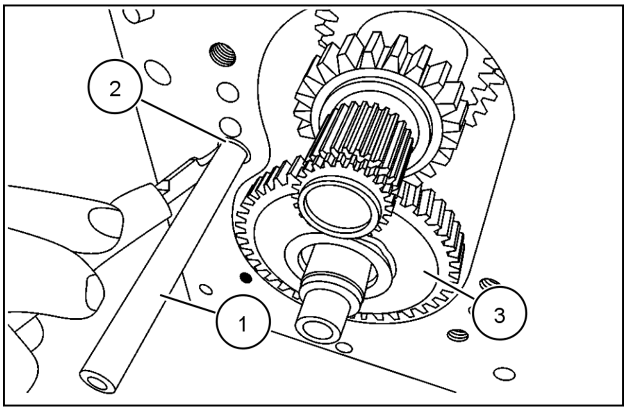


200900196 8

9. Secure the shift fork in place by inserting the bottom shift rail, **(1)**.

NOTE: *Insert the M12 plug,* ***(2)****, for the shift rail into the housing.*

10. Install 1st gear, **(3)**, onto the driven shaft.



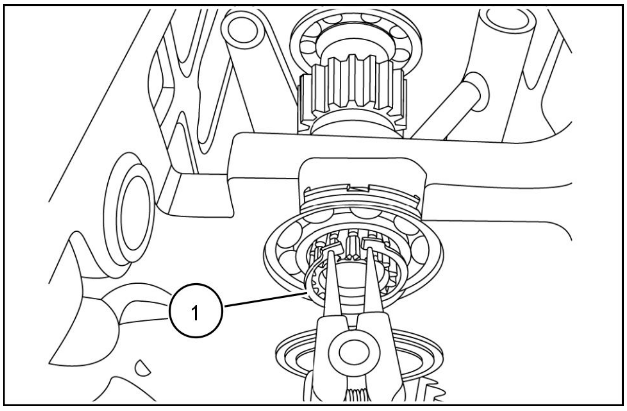
200900197 9

Next operation:
TRANSMISSION Mechanical - Assemble Intermediate plate (C.20.B)

Shaft - Remove Transmission Range Shaft

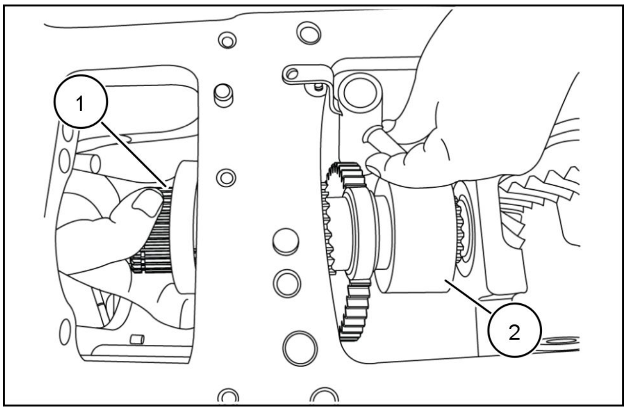
Prior operation:
Shaft - Remove Transmission Driven and Drive Shaft (C.20.B)

1. Remove the snap ring, **(1)**, from the range shaft



20098783 1

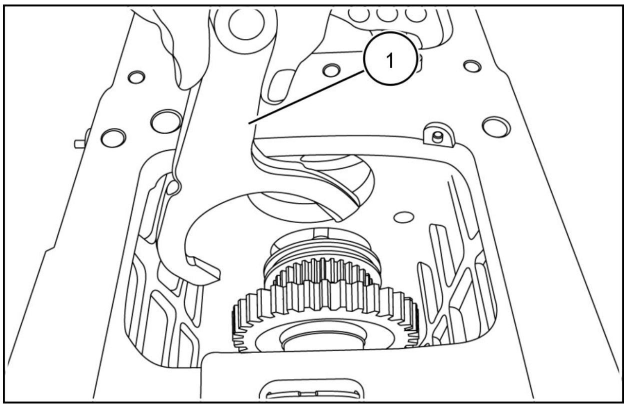
2. Remove the range shaft, **(1)**, from the housing and remove the oil feeder cup, **(2)**, from the shaft as shown



20098784 2

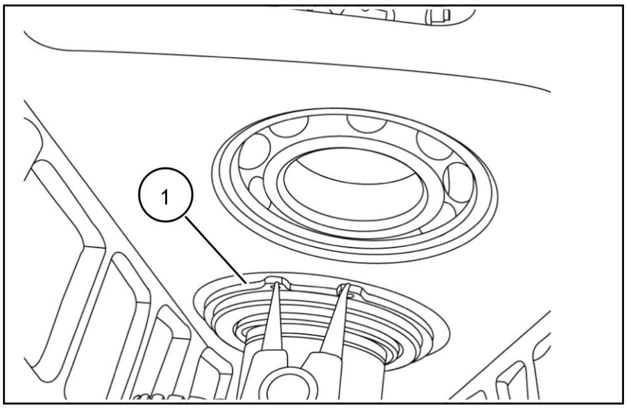
3. After removing the Hi/Low shift rail take out the high low shift fork, **(1)**.

NOTE: *Remove the spacer, spring and detent ball (not shown) from the Hi/low shift rail.*



20098785 3

4. Remove the snap ring, **(1)**, securing the range shaft bearing and remove bearing.



20098786 4

Next operation:
Shaft - Inspect Transmission Range Shaft (C.20.B)

Shaft - Inspect Transmission Range Shaft

Prior operation:
Shaft - Remove Transmission Range Shaft (C.20.B)

1. Wash all parts in a suitable cleaning solution and allow to air dry.
2. Inspect the range shaft for excess wear, chipped gear teeth, cracks or any other damage. Replace as necessary.
3. Inspect the shift fork and oil feeder cup for wear or damage. Replace as necessary.
4. Inspect the detent grooves in the shift rail for excess wear. Replace as necessary.
5. Check the detent springs for wear or weak spring tension. Replace as necessary.

Next operation:
Shaft - Remove Transmission Pinion shaft (C.20.B)

Shaft - Remove Transmission Pinion shaft

Prior operation:
Shaft - Remove Transmission Range Shaft (C.20.B)

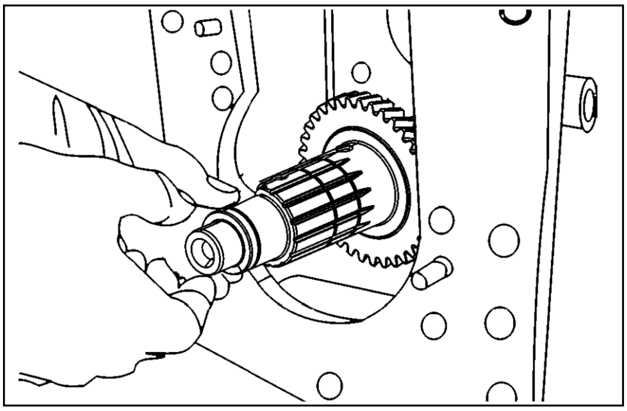
⚠ WARNING ⚠

Handle all parts carefully. Do not put your hands or fingers between parts. Always wear suitable safety items such as fitted clothing, safety goggles, gloves, shoes, etc. Failure to comply could result in death or serious injury.

M954A

NOTE: *It is required to remove PTO cover and related components along with the Transmission assembly.*

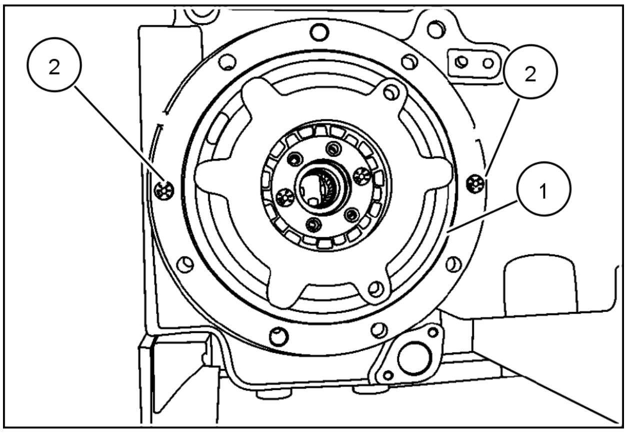
Remove the driven shaft, drive shaft and range shaft before removing the pinion shaft.



200900208 1

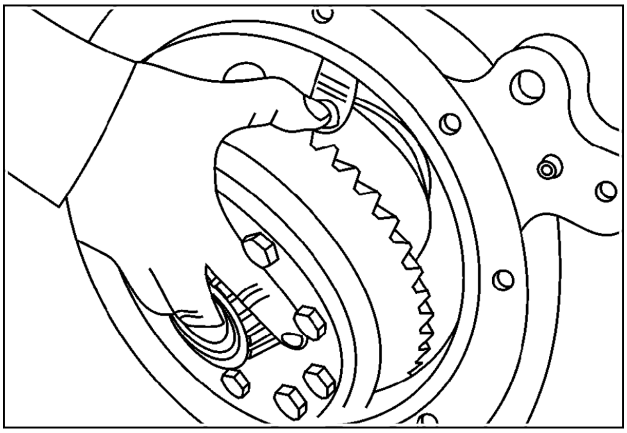
1. Remove the cover, **(1)**, from the housing by removing the two socket head cap screws, **(2)**.

NOTE: *Remove the o-rings from the cover.*



20097872 2

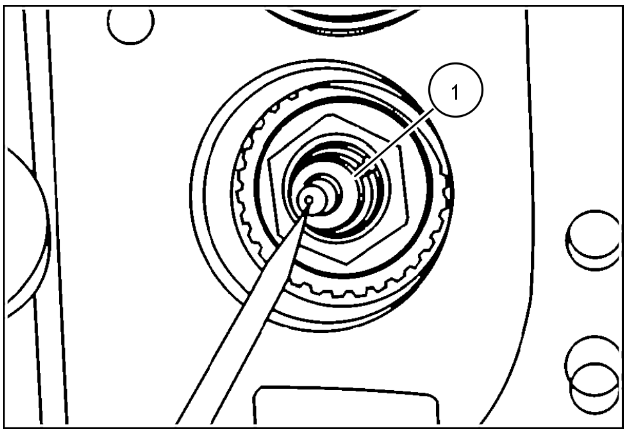
2. Remove the differential assembly following the procedure described in **Bevel gear - Remove (D.12.A)**.



20097832 3

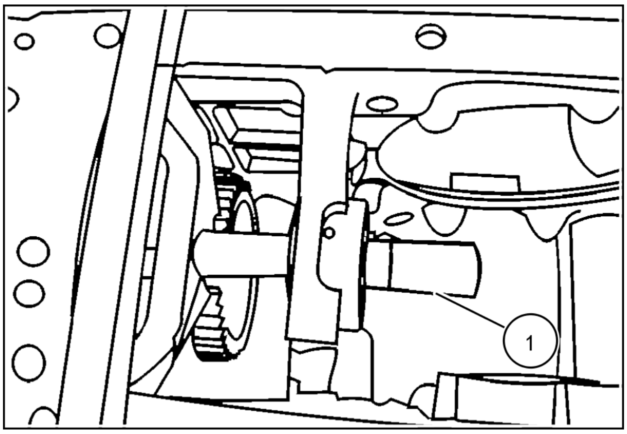
3. Use a hammer and special unstaking tool, **380000660**, to unstake the lock nut, **(1)**, from the keyway in the pinion shaft.

NOTE: *Discard the lock nut and use a new locknut during installation. Never reuse the locknut after it has been staked to the shaft and removed.*



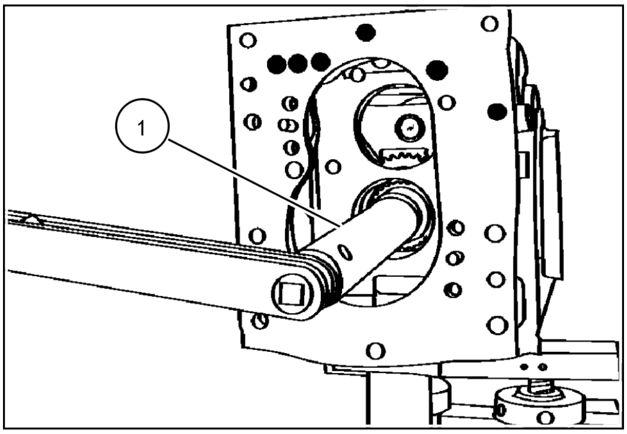
20097873 4

4. Fit the Pinion locking tool, **380002985**, **(1)**.



20097874 5

5. Remove the pinion shaft lock nut using , **380002982**.

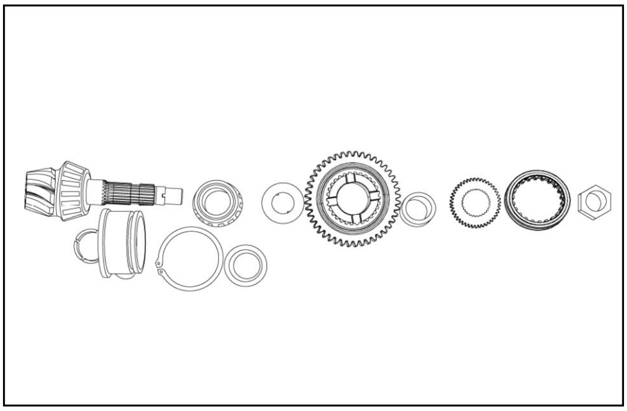


20097875 6

6. Remove the pinion shaft from the housing by using a hammer and aluminium / brass drift to drive the shaft rearward.

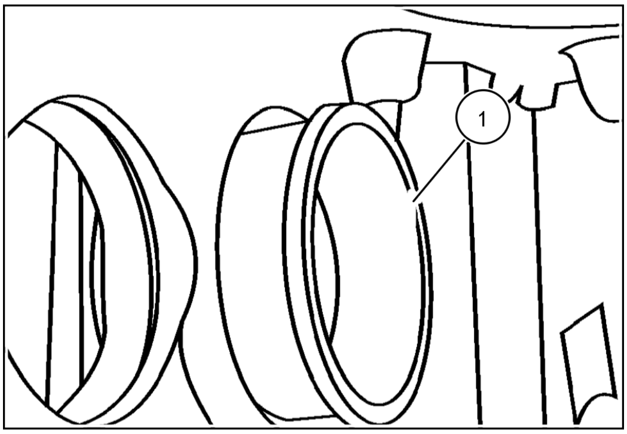
NOTE: *Remove the needle bearing, Hi / Low gear coupler, hub, low gear, bushing and bearing from the pinion shaft during removal.*

NOTE: *The bearing coupling assembly will not be removed when the pinion shaft is removed.*



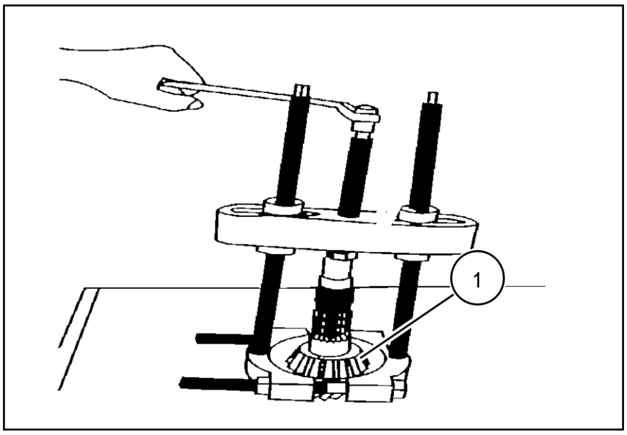
20098784-2 7

7. Remove the snap ring from the front of the bearing coupling assembly bearing race and remove the bearing race, **(1)** from the housing.



20097877 8

8. Remove the bearing, **(1)**, from the pinion shaft by using a puller or hydraulic press and bearing splitter.



20097878 9

Next operation:
Shaft - Inspect Transmission Pinion shaft (C.20.B)

Shaft - Inspect Transmission Pinion shaft

Prior operation:
Shaft - Remove Transmission Pinion shaft (C.20.B)

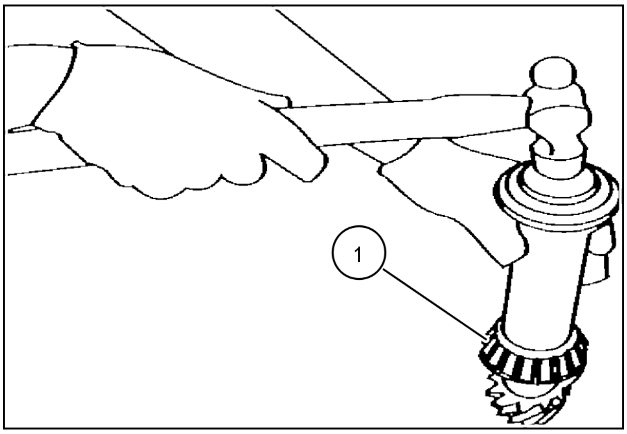
1. Wash all parts in a suitable cleaning solution and allow to air dry.
2. Inspect all bearings for excess wear, score marks, discoloration from overheating or other damage. Rotate the bearings by hand and check for any roughness while turning. Replace as necessary.
3. Inspect the pinion shaft for excess wear, chipped gear teeth, cracks or any other damage. Replace as necessary.
4. Inspect the gear coupler for excess wear or damage. Replace as necessary.

Next operation:
Shaft - Install Transmission Pinion shaft (C.20.B)

Shaft - Install Transmission Pinion shaft

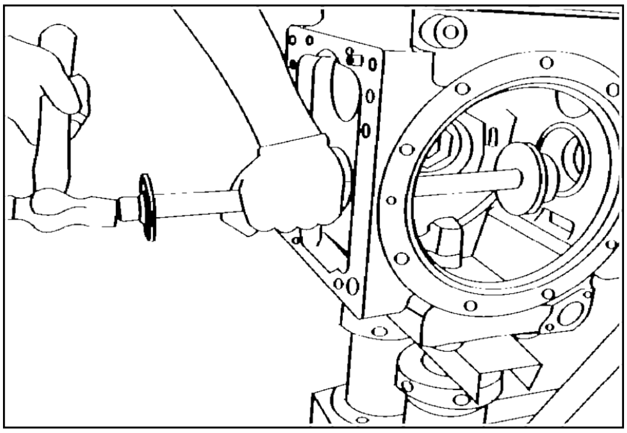
Prior operation:
Shaft - Inspect Transmission Pinion shaft (C.20.B)

1. Use a suitable driver or hydraulic press to install the bearing, **(1).** on the pinion shaft.



20097879 1

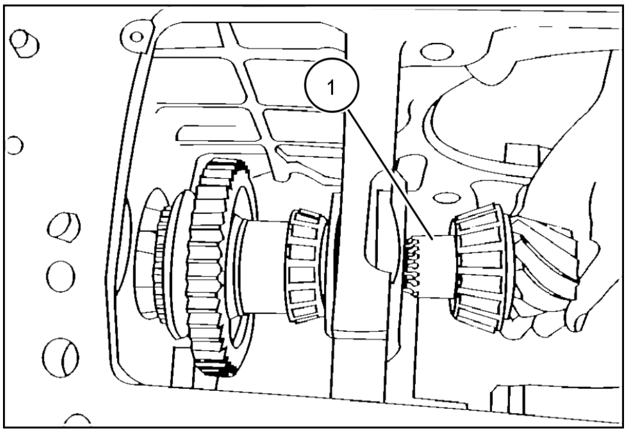
2. Use a suitable bearing race driver and hammer to drive the bearing race for the bearing coupling assembly into the housing.
3. Secure the front of the bearing coupling assembly bearing race with the snap ring.



20097880 2

4. Install the pinion shaft, **(1)**, into the housing.
5. Slide the bearing, bushing, low gear, hub, Hi / Low gear coupler and needle bearing onto the pinion shaft during installation.

NOTE: *Install the hub with the released side of hub facing the front of the pinion shaft.*



20097881 3

6. Install the locknut on the pinion shaft and tighten the nut using, **380002982**.
7. Adjust the pinion bearing preload (rolling torque) by wrapping a cord around the pinion shaft.
8. Attach the opposite end of the cord to a pull scale, **(1)**.
9. Tighten the locknut with a constant pull of **80.5 - 96.5 N** (**18.1 - 21.7 lb**) is required to rotate the pinion shaft.

NOTE: *Install the pinion locking tool,* ***380002985****, when tightening the lock nut.*

10. When the proper rolling torque is achieved, stake the lock nut to the keyway in the pinion shaft to maintain the adjustment.
11. Install the differential assembly following the procedure described in **Bevel gear - Remove (D.12.A)**.

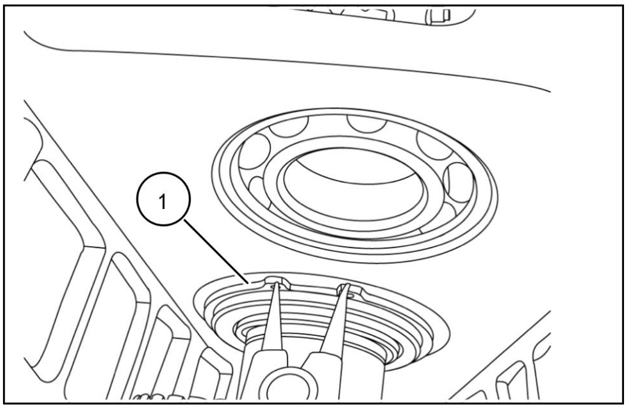
Next operation:
Shaft - Install Transmission Range shaft (C.20.B)

Shaft - Install Transmission Range shaft

Prior operation:
Shaft - Install Transmission Pinion shaft (C.20.B)

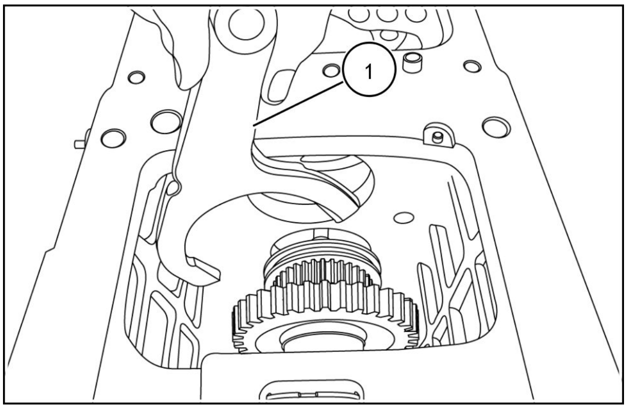
NOTE: *Range shaft to be installed after the installation of pinion shaft and differential assembly.*

1. Install the range shaft bearing in the housing and secure using the snap ring, **(1)**.
2. Install the Spacer , Spring and detent ball (not shown) on the Hi/Low shift rail.



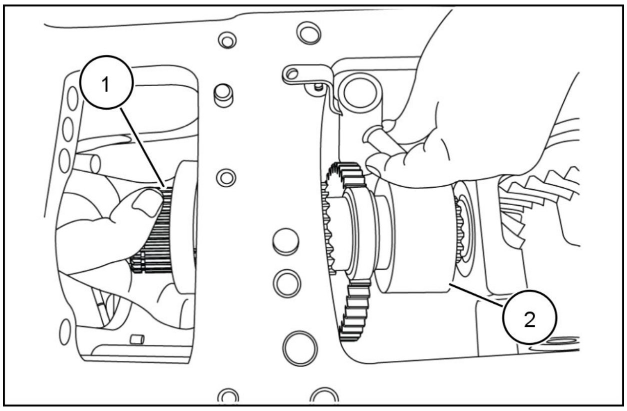
20098786 1

3. Install the Hi/Low shift rail and install the shift fork, **(1)**.



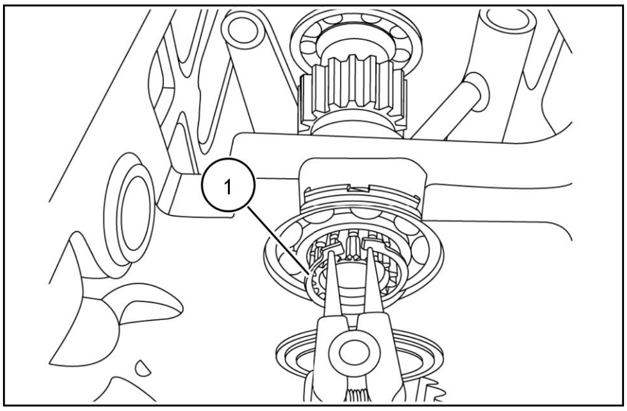
20098785 2

4. Install the range shaft, **(1)**, into the housing and install the oil feeder cup, **(2)**, onto the shaft as shown.



20098784 3

5. Secure the range shaft with the snap ring, **(1)**.

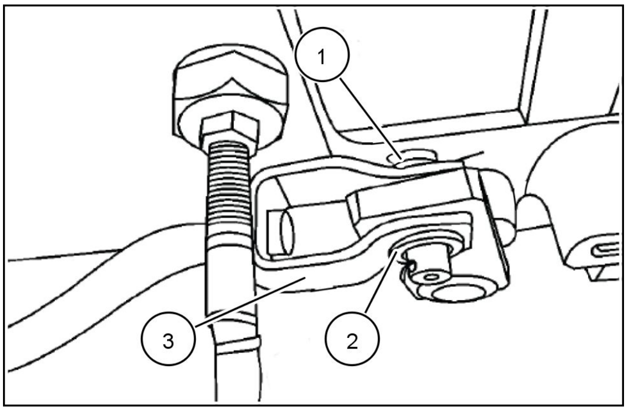


20098783 4

Gear and synchroniser - Remove Transmission Synchronizer kit and Cluster Gear Assembly

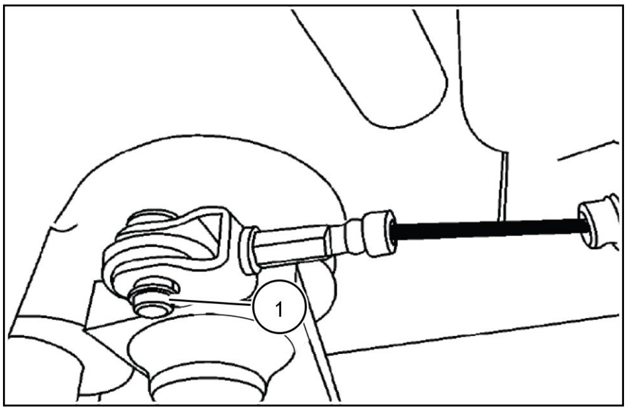
Prior operation:
TRANSMISSION Mechanical - Remove Transmission assembly (C.20.B)

1. Remove the split pins, **(1)** and **(2)** to release the link, **(3)**.



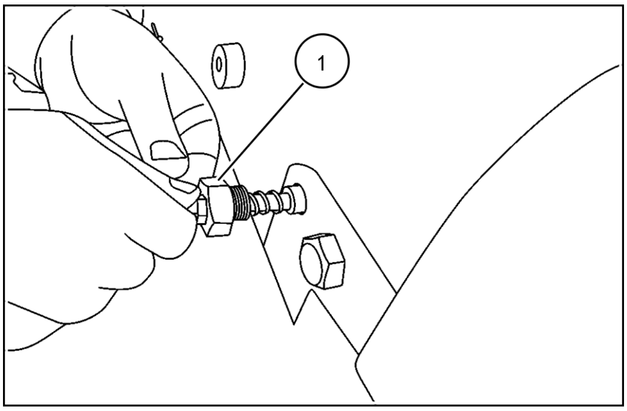
20099938 1

2. Remove the circlip lock, **(1)**.



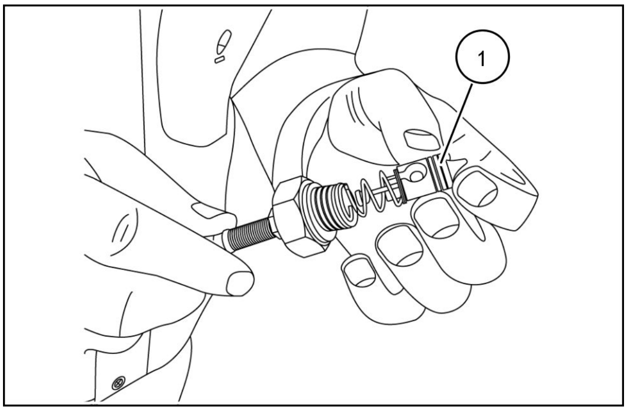
20099939 2

3. Remove the shuttle wire, **(1)**, as shown.



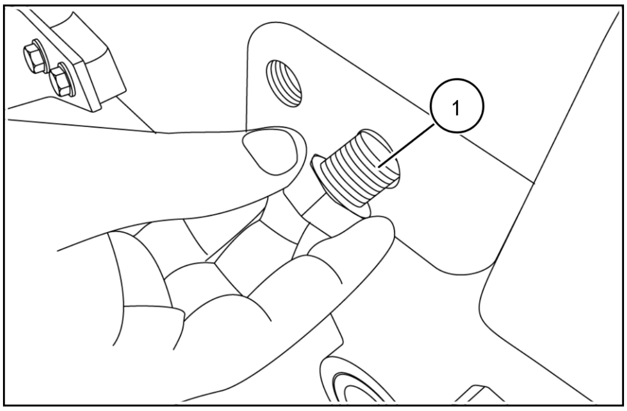
200900181 3

4. Collect the spring and the pin, **(1)**, as shown.



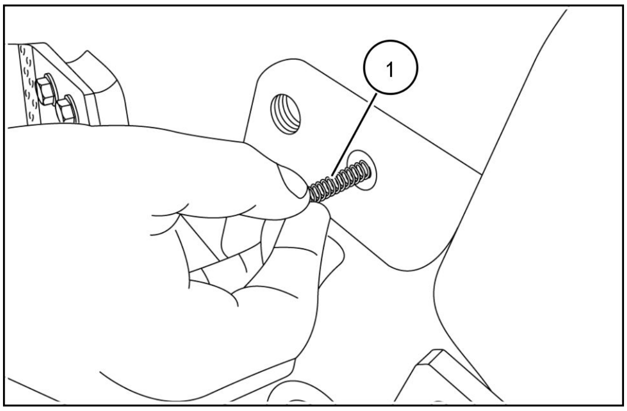
200900182 4

5. Remove the shuttle detent bolt from the left-hand side of the clutch housing.



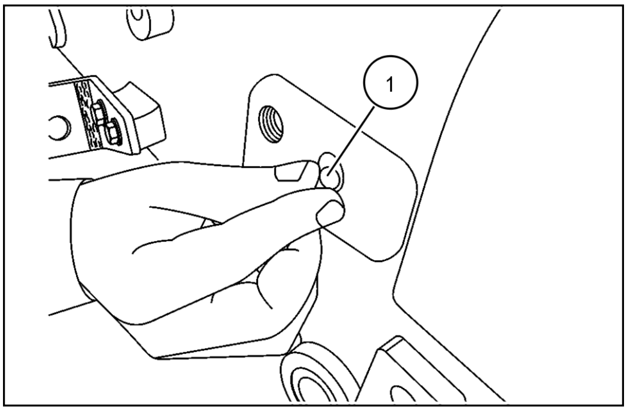
200900183 5

6. Remove the spring **(1)**, from the hole in the clutch housing.



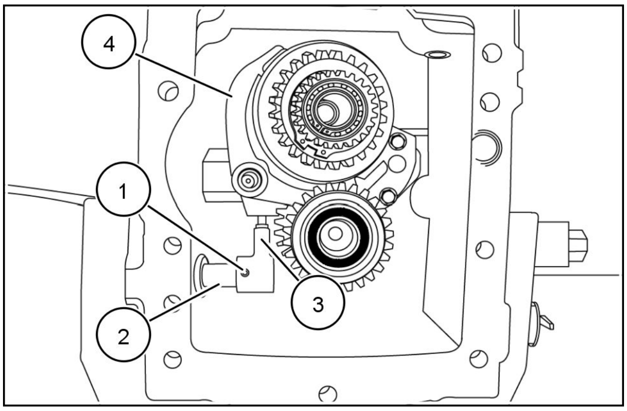
200900184 6

7. Remove the detent ball, **(1)**, from the hole in the clutch housing.



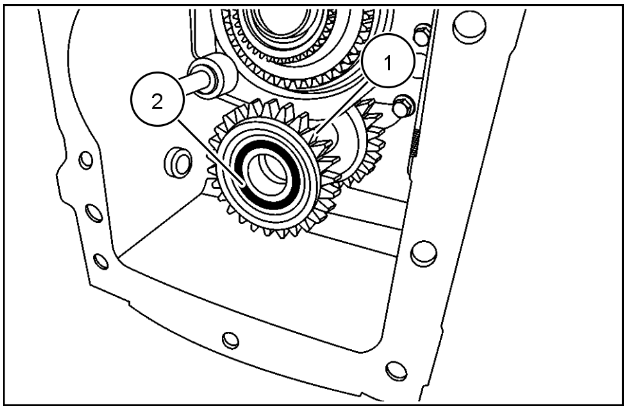
200900185 7

8. Remove the roll pin, **(1)**, aligning the shaft link rod, **(2)** and lever link rod, **(3)**.
9. Slide the shaft link rod, **(2)**, out from the lever link rod, **(3)**, and remove the shaft link rod, **(2)**, from the cluster housing.
10. Remove the lever link rod, **(3)**, from the shift fork, **(4)**.
11. Remove the o-rings from the shaft link rod, **(2)**.



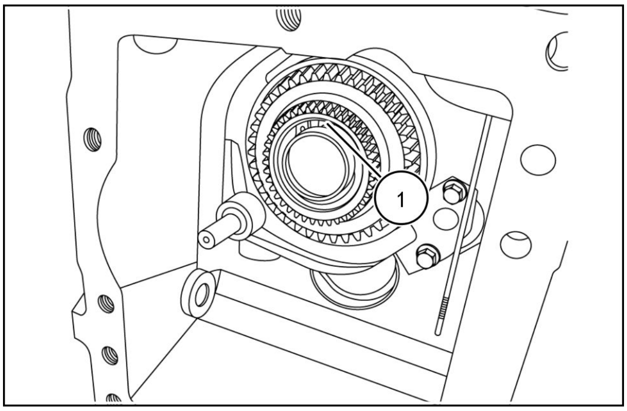
200900265 8

12. Remove the cluster gear shaft **(1)**, from the ball bearing.
13. Remove the ball bearing, **(2)**, from the cluster gear shaft, **(1)**.



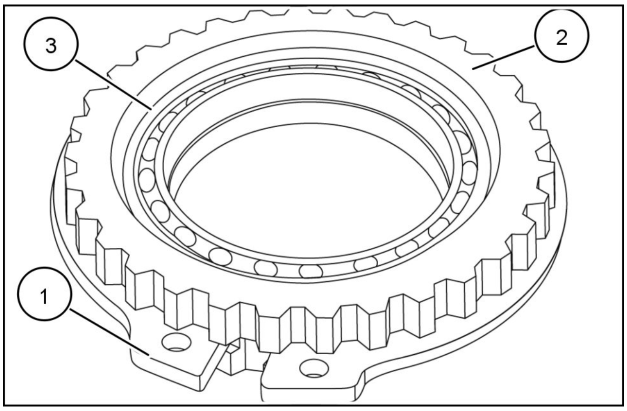
200900257 9

14. Remove the external circlip, **(1)**, from the groove of the input shaft.
15. Remove the shuttle coupler gear assembly from the input shaft.



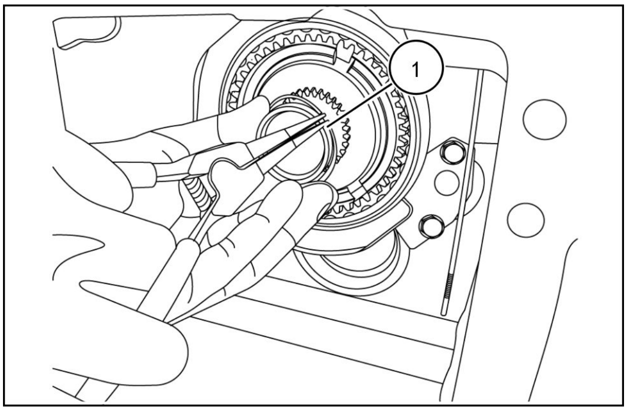
200900187 10

16. Remove the external retaining ring, **(1)**, from the groove of coupler shuttle gear, **(2)**.
17. Remove the ball bearing, **(3)**, inside the coupler shuttle gear, **(2)**.



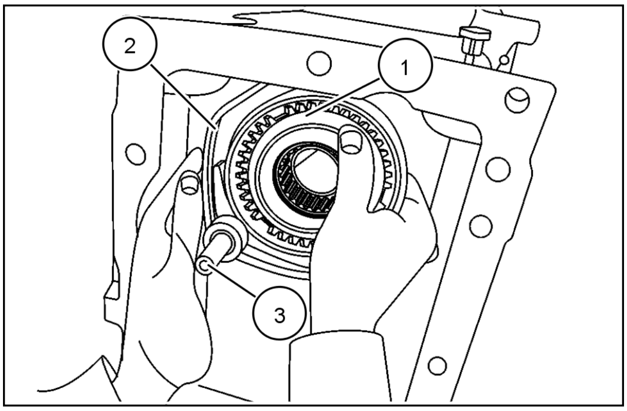
20098795 11

18. Remove the snap ring, **(1)**, from the groove of the input shaft.



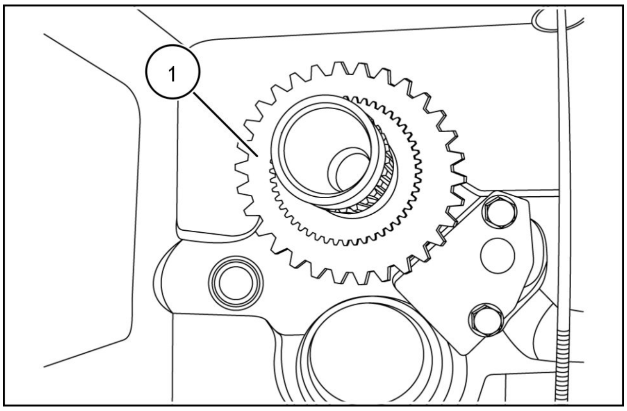
200900189 12

19. Remove the synchroniser kit, **(1)**, shift fork, **(2)** and rail, **(3)**.



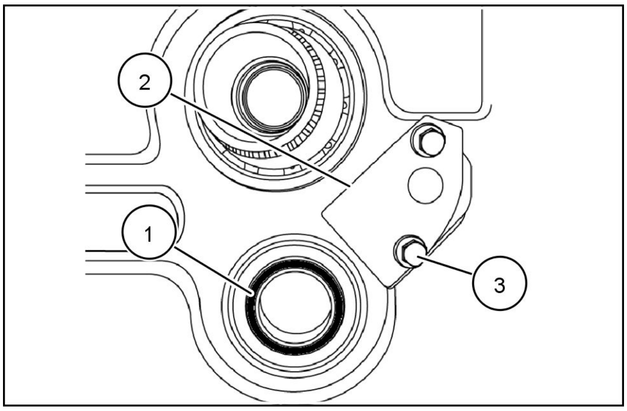
200900190 13

20. Remove the reverse gear, **(1)**.



200900191 14

21. Remove the ball bearing, **(1)**, from the rear of the clutch housing.
Remove the oil trench plate, **(2)**, from the housing surface by loosening the M8 bolts and washers, **(3)**.



200900266 15

Next operation:
Gear and synchroniser - Inspect Transmission Synchronizer kit and Cluster Gear Assembly (C.20.B)

Gear and synchroniser - Inspect Transmission Synchronizer kit and Cluster Gear Assembly

Prior operation:
Gear and synchroniser - Remove Transmission Synchronizer kit and Cluster Gear Assembly (C.20.B)

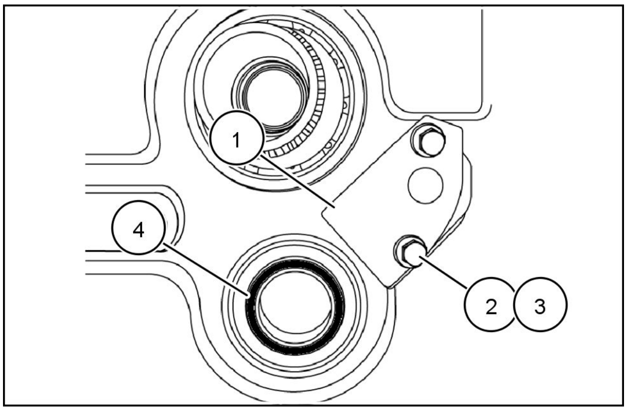
1. Wash all parts in a suitable cleaning solution and allow to air dry.
2. Inspect the bearings for excess wear, scoremarks , discoloration from overheating or other damage. Rotate the bearings by hand and check for any roughness. Replace as necessary.
3. Inspect the synchronizer gears and cluster gear shaft for excess wear, chipped gear teeth, cracks or any other damage. Replace as necessary.
4. Inspect the shift fork for wear or damage. Replace as necessary
5. Inspect the detent grooves in the shift rail for excess wear. Replace as necessary.
6. Check the detent spring for wear or weak spring tension. Replace as necessary.

Next operation:
Gear and synchroniser - Install Transmission Synchroniser kit and Cluster Gear Assembly (C.20.B)

Gear and synchroniser - Install Transmission Synchroniser kit and Cluster Gear Assembly

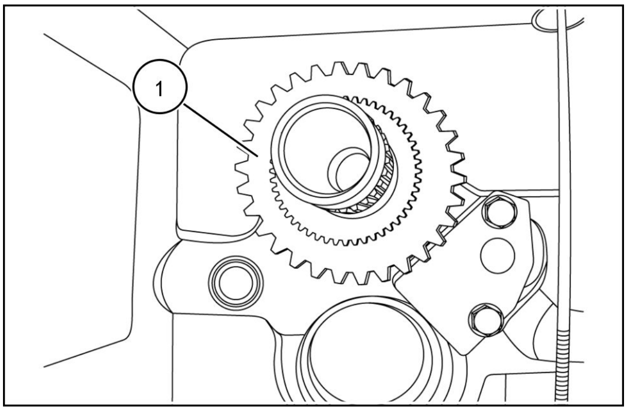
Prior operation:
Gear and synchroniser - Inspect Transmission Synchronizer kit and Cluster Gear Assembly (C.20.B)

1. Place the oil trench plate, **(1)**, on the housing surface and tighten the M8 bolts, **(2)**, with washer, **(3)**, to **25.5 N·m** (**18.8 lb ft**).
   Install the ball bearing, **(4)**, from the rear of the clutch housing.



200900266 1

2. Install the reverse gear, **(1)**, over the input shaft spacer.

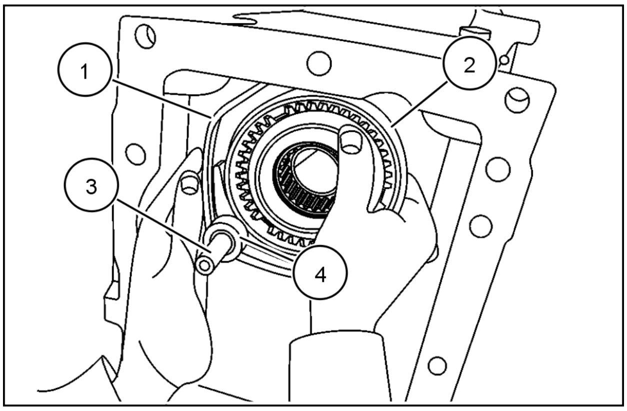


200900191 2

3. Install the shift fork, **(1)**, onto the synchronizer, **(2)**.
4. Insert the shift rail, **(3)**, through the shift fork, **(1)**.

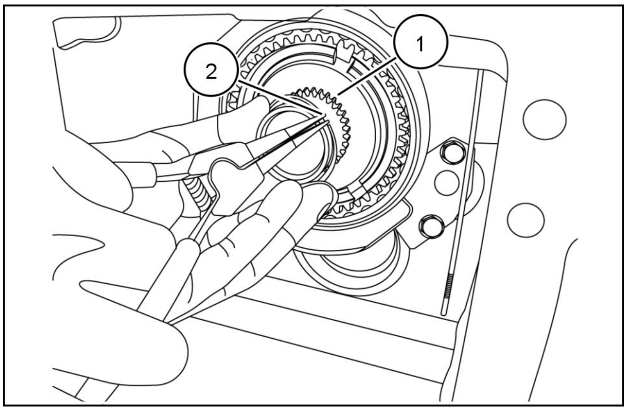
NOTE: *Secure the spring and detent ball against the groove on the shift rail by installing the shuttle detent bolt on the left-hand side of the clutch housing.*

5. Install roll pin **(4)**, after aligning the hole of the shift fork, **(1)**, and shift rail, **(3)**.



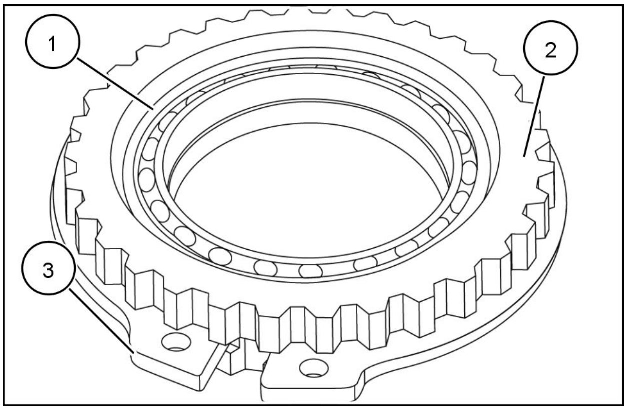
200900190 3

6. Install the synchronizer kit, **(1)**, onto the spline of the input shaft.
7. Secure the synchronizer on the input shaft with the external retaining ring, **(2)**.



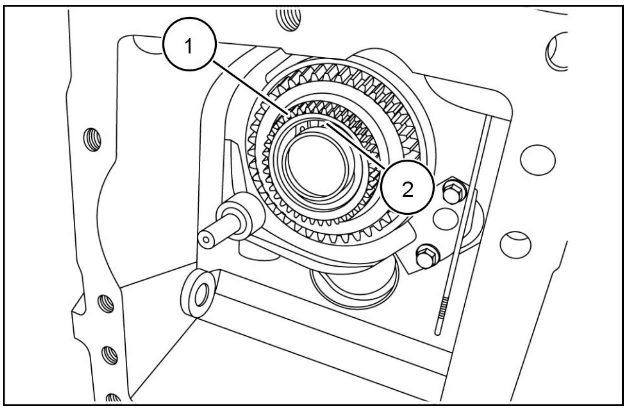
200900189 4

8. Press the ball bearing, **(1)**, inside the coupler shuttle gear, **(2)**.
9. Attach the external snap ring, **(3)**, onto the groove of coupler shuttle gear, **(2)**.



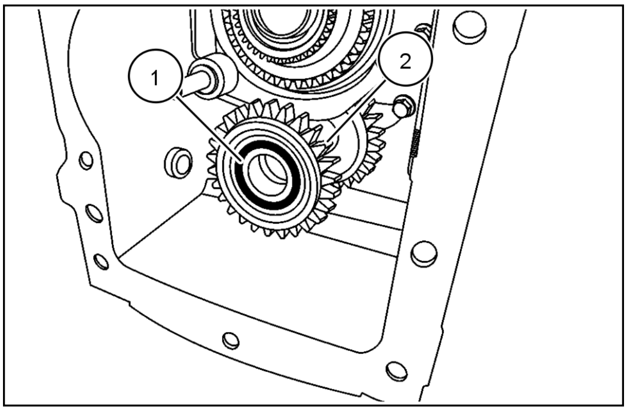
20098795 5

10. Install the shuttle coupler gear assembly, **(1)**, over the input shaft.
11. Secure the shuttle coupler gear on the input shaft with the external snap ring, **(2)**.



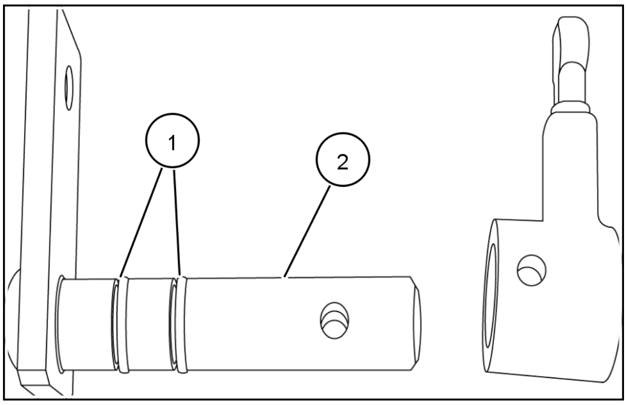
200900187 6

12. Press the ball bearing, **(1)**, into the cluster gear shaft, **(2)**.
13. Install the cluster gear shaft, **(2)**, into the ball bearing installed from step 2.



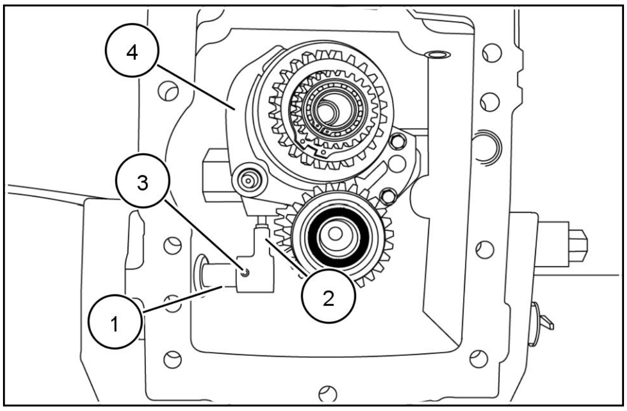
200900257 7

14. Apply petroleum jelly to the o-rings, **(1)**.
    Insert the o-rings in the grooves on the shaft link rod, **(2)**.



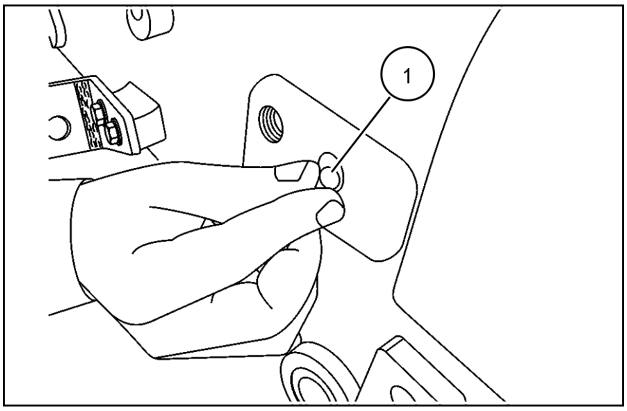
20098794 8

15. Insert the shaft link rod, **(1)**, through the hole in the clutch housing.
16. Insert the lever link rod, **(2)**, in the shift fork, **(4)**.
17. Slide the shaft link rod, **(1)**, into the lever link rod, **(2)**.
18. Align the holes in the shaft link rod, **(1)**, with the holes in the lever link rod, **(2)**. Secure using the roll pin, **(3)**.



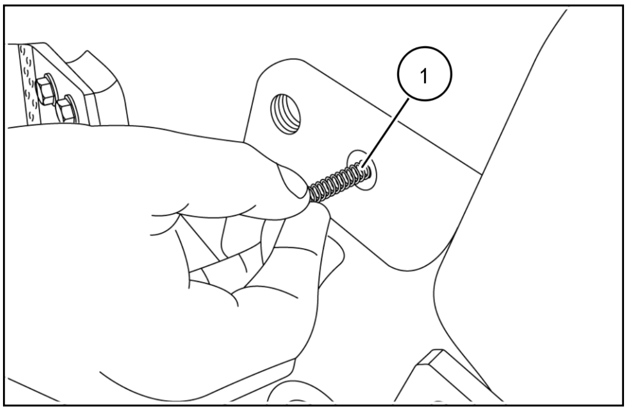
200900265 9

19. Insert the detent ball, **(1)**, in front of the spring.



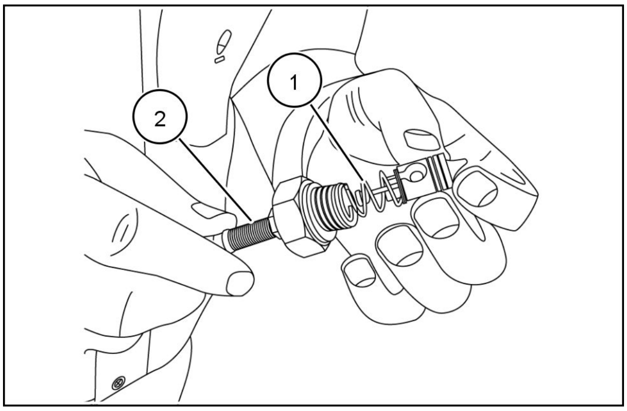
200900185 10

20. Insert the spring, **(1)**, into the clutch housing.
21. Install the shuttle detent bolt to the left-hand side of the clutch housing.



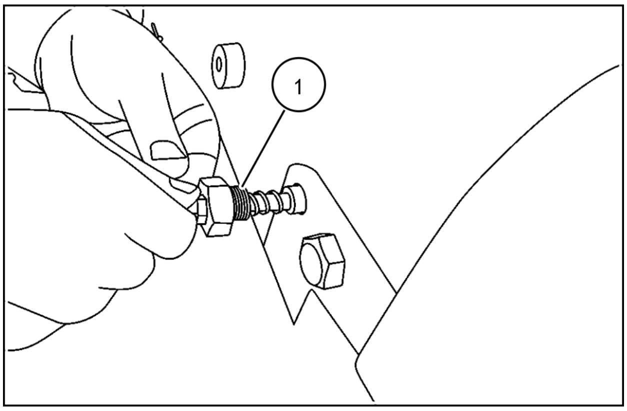
200900184 11

22. Insert the pin and spring, **(1)**, to shuttle cable, **(2)**.



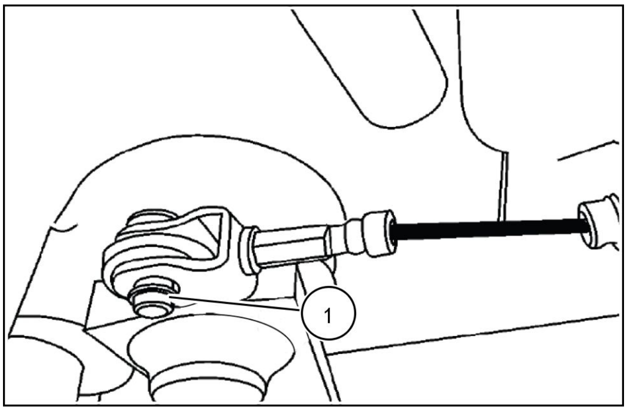
200900182 12

23. Insert the shuttle cable, **(1)** through the hole on the left-hand side of the clutch housing.



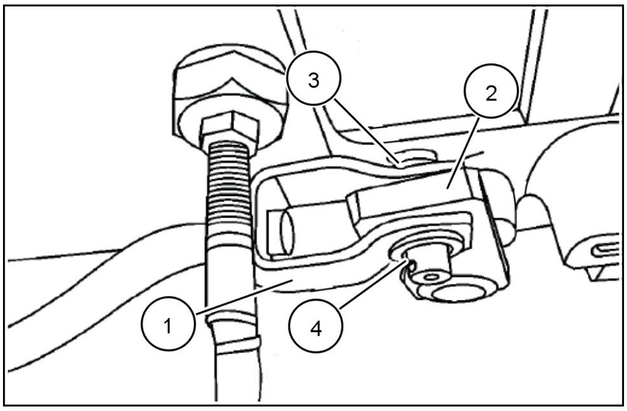
200900181 13

24. Attach the cable on the linkage and secure with the snap ring, **(1)**.



20099939 14

25. Attach the linkage, **(1)**, to the shaft link rod, **(2)**. Secure using the pin, **(3)** and cotter pin, **(4)**.

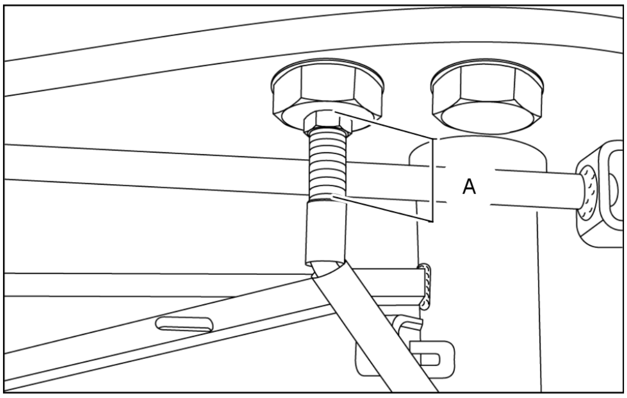


20099938 15

Gear and synchroniser - Adjust - Shuttle interlock cable

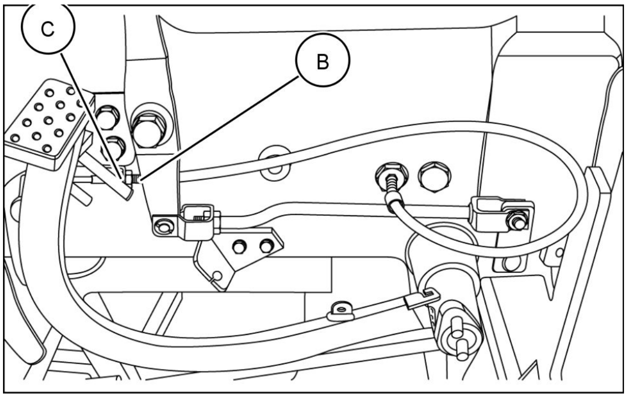
Prior operation:
Gear and synchroniser - Install Transmission Synchroniser kit and Cluster Gear Assembly (C.20.B)

1. Measure dimension **(A)** at cable end as shown in figure **1** (Top of nut to bottom of threads). The desired length of **(A)** is approximately **26 mm** (**1.0 in**); adjust if required.



93102730 1

2. At the opposite cable end, count the number of visible threads **(B)**; there should be 6 or 7. Thread length can be changed by adjusting the nuts on either side of cable mounting bracket **(C)**



93102731 2

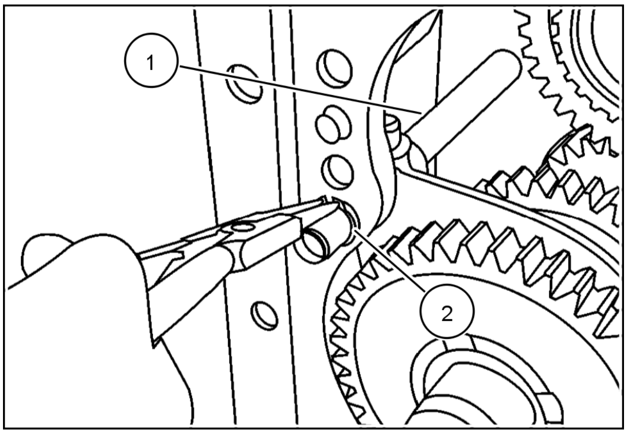
3. Adjust the nuts so that the shuttle lever starts to move when clutch pedal is depressed beyond free play (**50 - 55 mm** (**2.0 - 2.2 in**) from rest) and then tighten.

Fork and shift rail - Install Transmission Rails and Fork

Prior operation:
TRANSMISSION Mechanical - Assemble Intermediate plate (C.20.B)

To install the shift rail and shift forks follow the procedure as mentioned below.

1. Insert the bottom shift rail, **(1)**, and 1st/2nd gearshift fork. Insert the snap ring, **(2)**, on the bottom shift rail and ensure it sits on the seat in housing.



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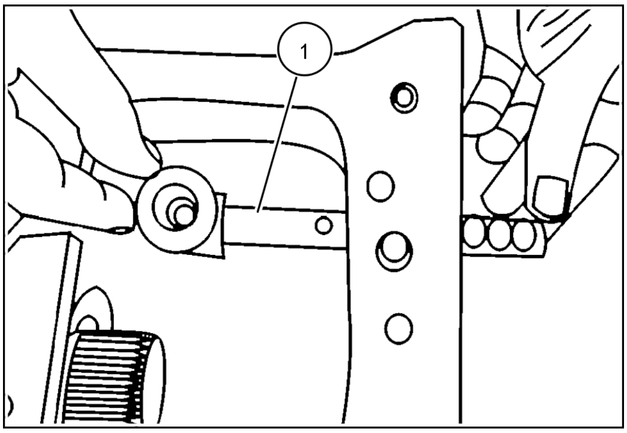
2. The Hi/low shift rail, **(1)**, shift fork, and shift gate should be installed after the pinion and crown settings.

NOTE: *Keep grooves of rails upward to make easy fitment of balls and springs.*



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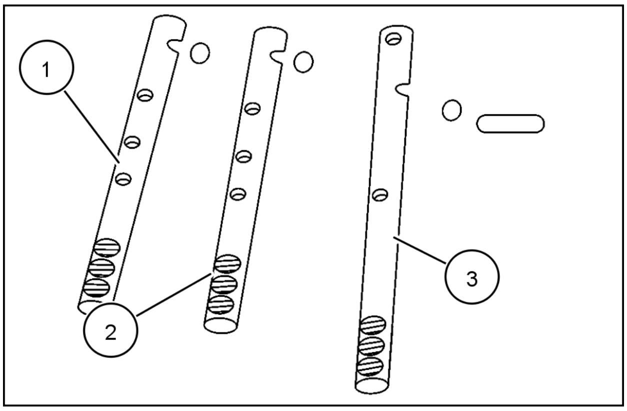
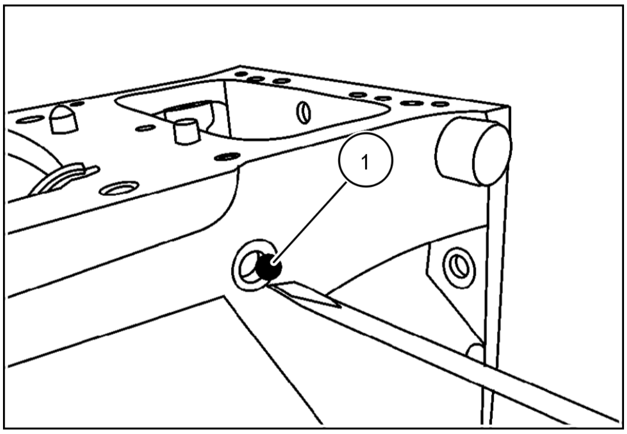
3. Transmission shift rails can be identified by referring to Figure **3**.To fit rails 1st/2nd **(1)** and 3rd/4th **(2)** rails are similar. After fitting range shaft and drive shaft fit fork for 3rd/4th and insert reverse rail **(3)**, passing through fork of 3rd/4th gear.



200900174 3

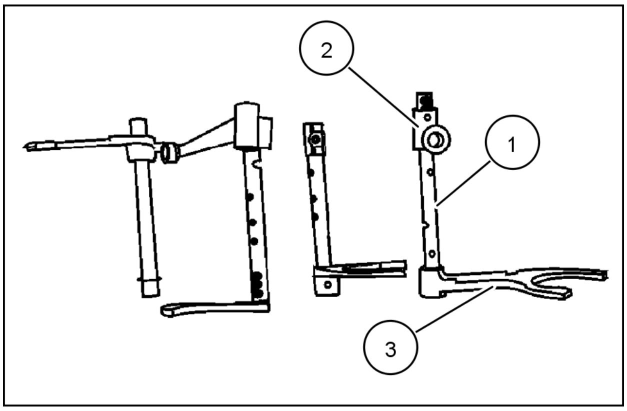
4. After fitting reverse rail insert ball **(1)**, applying some grease in the housing.



20097886 4

5. Insert the rail **(1)**, of 3rd/4th with gate **(2)**, passing through fork **(3)**, of 3rd/4th gear as shown in Figure **5**.

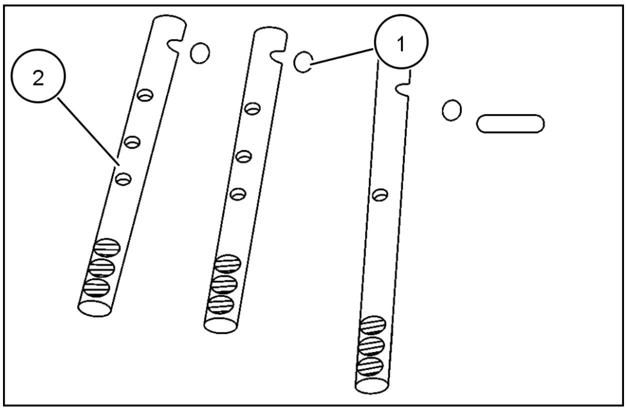
   Insert gate of 1st/2nd rail shaft on the notch of 1st/2nd gear fork.



200900175 5

6. Insert the ball **(1)**, applying some grease in housing after removing bolt as shown in Figure **4**.
7. Insert the 1st/2nd rail **(2)**, passing thru gate as shown in Figure **5**.

NOTE: *Keep grooves of rails upward to make easy fitment of balls and springs.*



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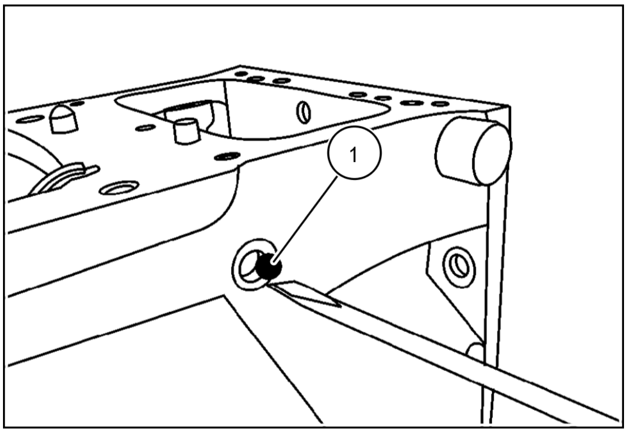
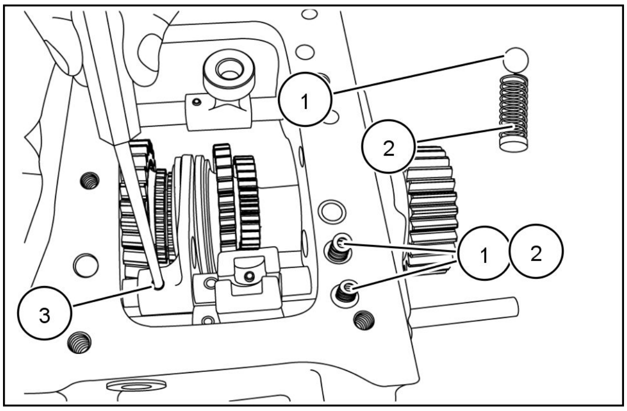
8. Insert the ball and pin **(1)**, after removing neutral safety switch for Hi/Low rail then fit neutral safety switch and tighten it.



20097886 7

9. After fitting reverse rail insert ball **(1)**, applying some grease in the housing as such it sits in groove given on reverse rail.
10. Insert the balls **(1)** and springs **(2)** of the rails. Insert plug above the spring of Hi/Low rail. Fit roll pins **(3)**, in all rails and gates.



20099991 8

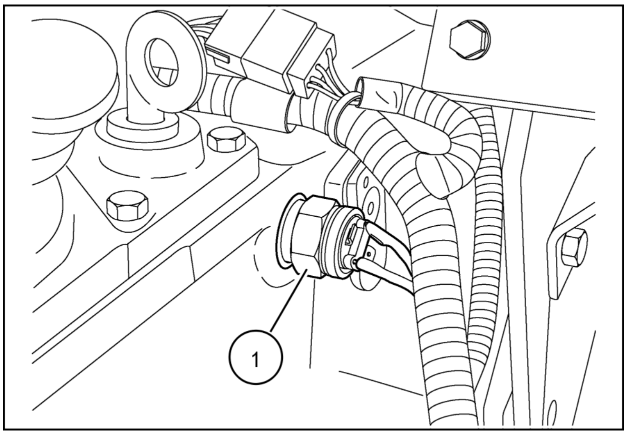
Next operation:
TRANSMISSION Mechanical - Install Transmission assembly (C.20.B)

Sensing system - Remove Transmission range safety switch

1. Disconnect the negative (-) battery cable from the negative (-) battery terminal.

NOTE: *Switch is protected with a rubber boot.*

2. Disconnect the transmission range safety switch, **(1)**, from the tractor wire harness.
3. Unthread the switch, **(1)**, with sealing washer from the transmission housing.



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Next operation:
Sensing system - Test Transmission range safety switch (C.20.B)

Sensing system - Test Transmission range safety switch

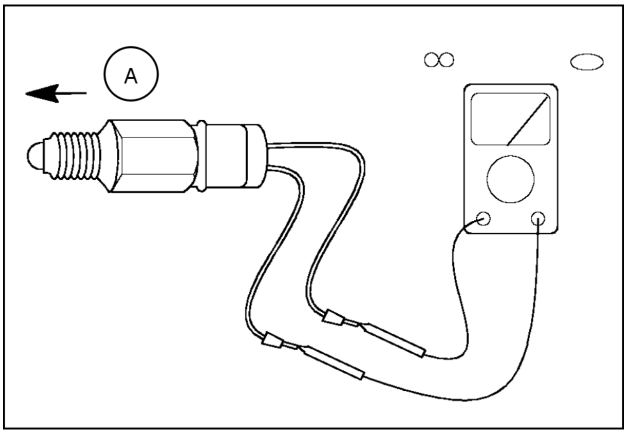
Prior operation:
Sensing system - Remove Transmission range safety switch (C.20.B)

NOTE: *Use an ohmmeter to test the transmission range safety switch for electrical continuity.*

Extended Position

1. With the transmission range safety switch plunger in the extended position "A", there will be electrical continuity across the terminal leads.

1. If continuity does not exist while the switch is in the "Extended " position, the switch is defective and needs replaced.



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Retracted Position (Not Shown)

1. With the switch plunger in retracted position, continuity will not exist between the terminal leads.

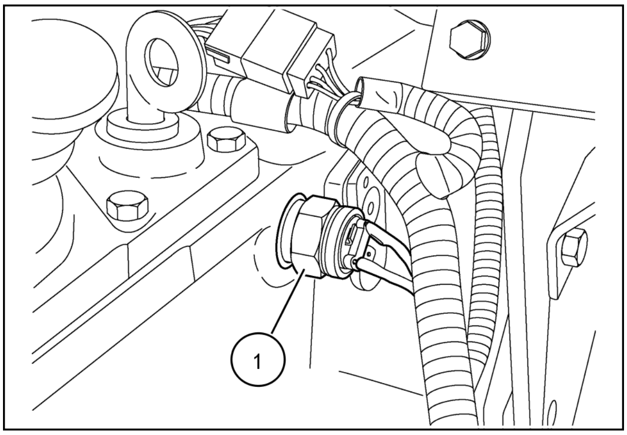
2. If continuity exits while the switch is in the "Retracted" position, the switch is defective and needs replaced.

Next operation:
Sensing system - Install Transmission range safety switch (C.20.B)

Sensing system - Install Transmission range safety switch

Prior operation:
Sensing system - Test Transmission range safety switch (C.20.B)

1. Thread the transmission range safety switch, **(1)**, with sealing washer into the left side of the transmission.
2. Connect the safety switch leads to the tractor wire harness.
3. Connect the negative (-) battery cable to the negative (-) battery terminal.



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Sensing system - Test Transmission clutch safety switch

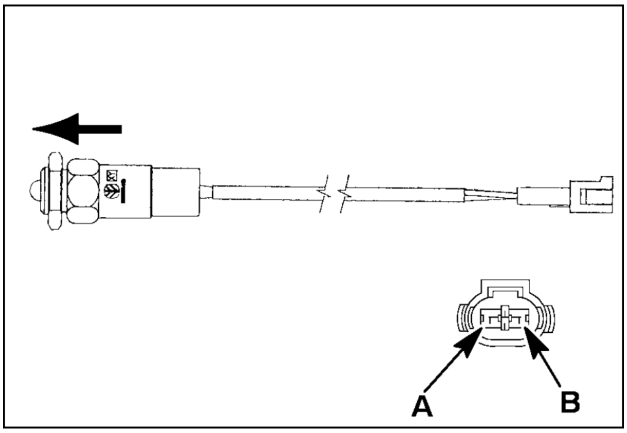
NOTE: *Use an ohmmeter to test both of the positions of the clutch safety switch for electrical continuity.*

Retracted Position (not shown)

Push the clutch safety switch into the "retracted" (OFF) position, continuity should not exist. If continuity exists while the switch is in the "retracted" position, the switch is defective and needs replaced.

Extended Position

Using an ohmmeter, touch one of the test probes to terminal "A". Touch the other test probe to terminal "B". There should be continuity between the terminals. If the continuity does not exist while the switch is in the "Extended" position, the switch is defective and needs replaced.



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TRANSMISSION Mechanical - Troubleshooting

Problem	Possible Cause	Correction
Noisy operation with range in neutral and main lever engaged	Input and output shaft support bearing mis-adjusted.	Remove transmission housing and adjust bearings.
	Failed or defective inner component.	Remove housing, overhaul transmission and replace faulty parts.
	Internal component seizure due to poor lubrication.	Overhaul transmission and top up oil to correct level.
Noisy operation with tractor stationery, idling engine and transmission in neutral	Faulty clutch plate springs.	Replace clutch plates.
Self disengagement of speed, range gears	External linkage and levers mis-adjusted.	Adjust correctly.
	Failed control rail retaining springs.	Replace springs.
	Partial engagement travel.	Correct reasons for problem and restore full travel.
Difficult engagement of speed and range gears	External levers mis-adjusted.	Adjust correctly.
	External levers stiff or seized.	Check pivot points and correct.
	Internal control items (rails, forks and sleeves) slide with difficulty.	Overhaul control items.

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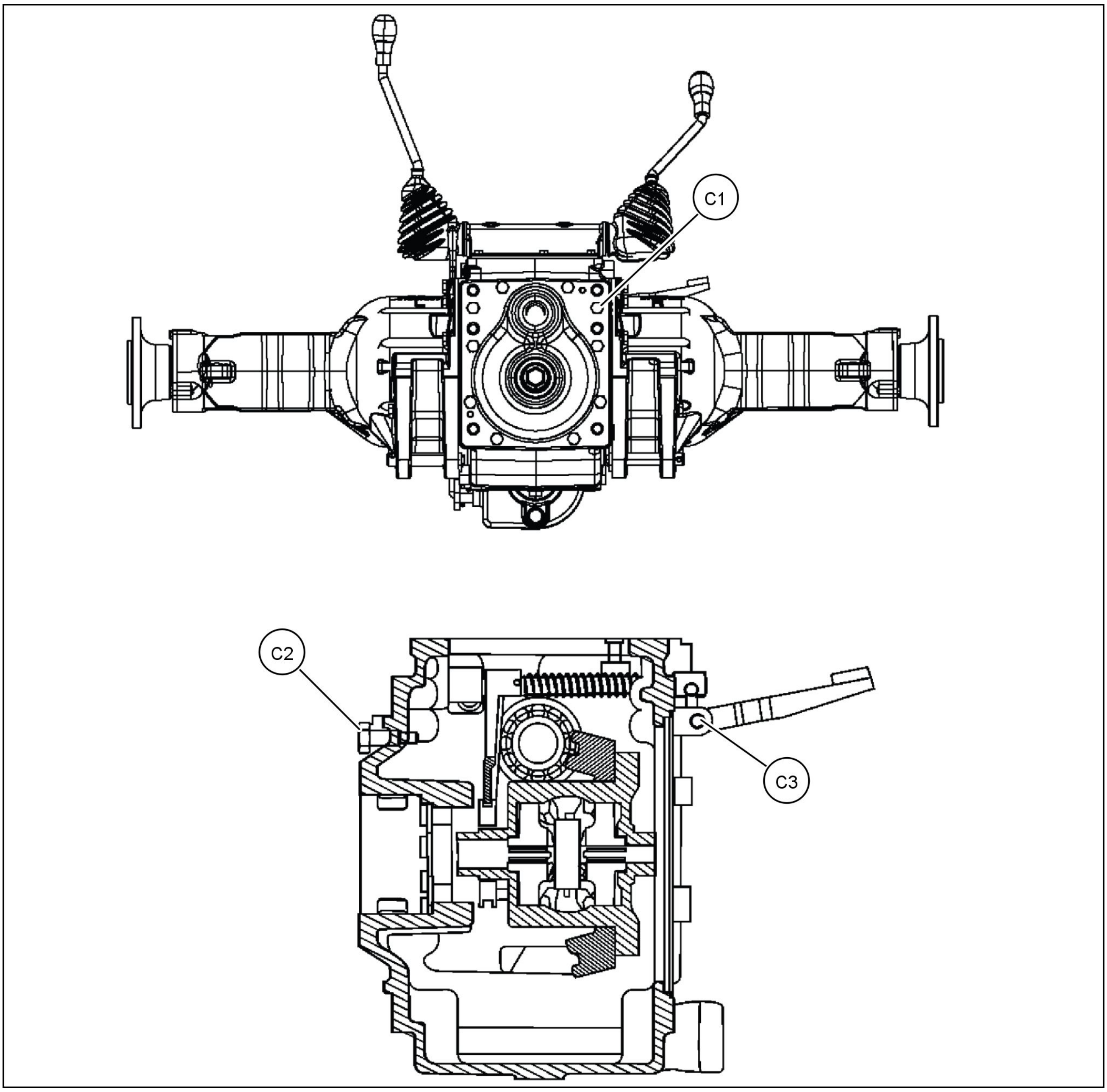
REAR PTO Mechanical - General specification

Type Engagement and control Rotation (looking from tractor rear end)	Fully independent of ground speed Through mechanical clutch Clock wise
Engine speed • **540 RPM** (standard) PTO speed	**2575 RPM**
Output Shaft Number of splines Shaft diameter	6 **28.86 - 28.96 mm** (**1.136 - 1.14 in**) (at root diameter)

REAR PTO Mechanical - Torque

Description	Thread Size (mm)	Torque N·m (lb ft)
PTO case mounting bolts **(C1)**	M12 X 1.25 X 25	**98 N·m** (**72.28 lb ft**)
PTO lever plate screws **(C2)**	M8 X 16	**8.8 N·m** (**6.49 lb ft**)
Differential lock pedal screw **(C3)**	M10 X 1.25 X 30	**58.8 N·m** (**43.37 lb ft**)



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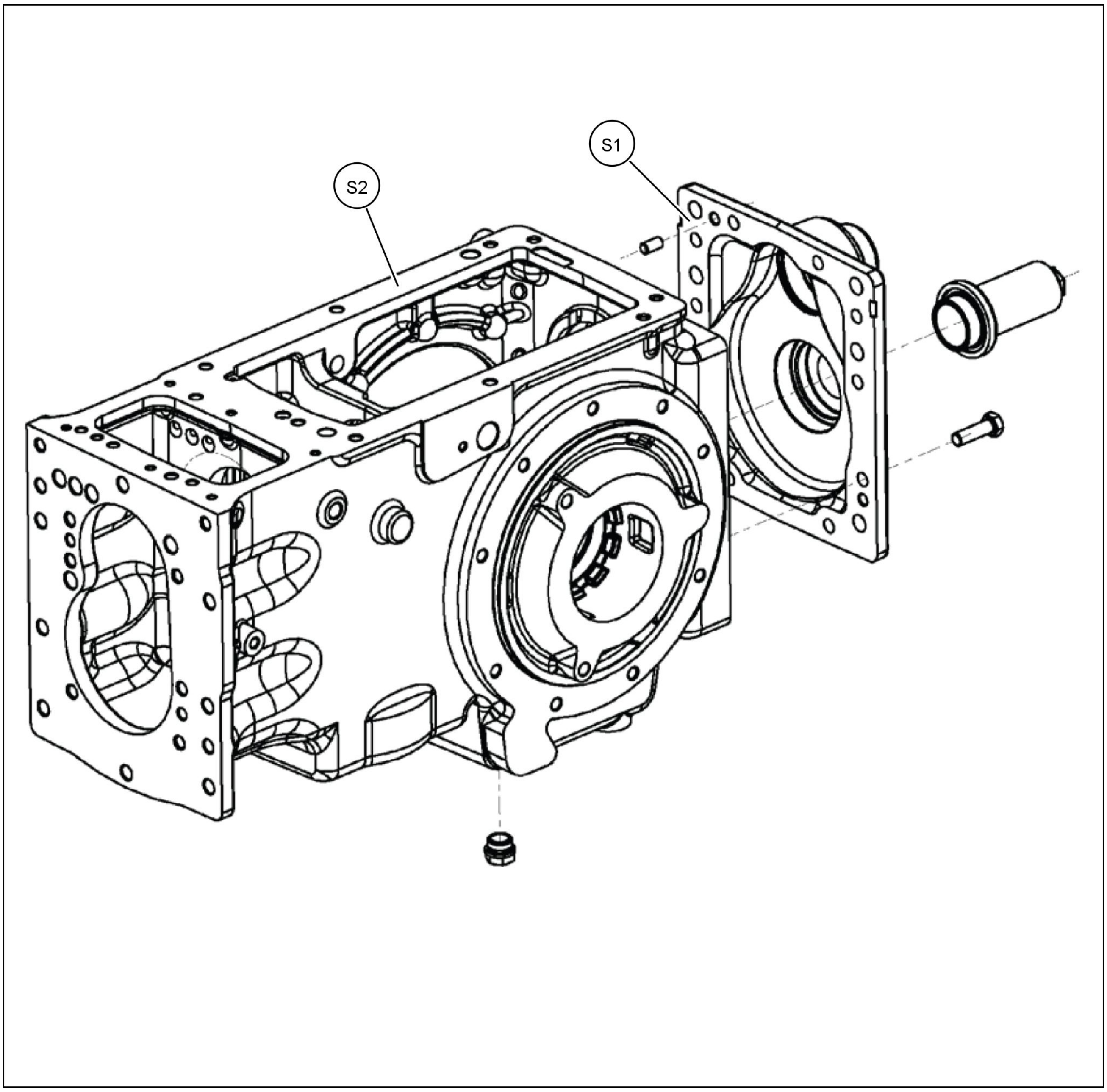
REAR PTO Mechanical - Sealing

Operation Description	Sealant Specification
PTO rear cover **(S1)**	**LOCTITE® 518**
Hydraulic to Transmission housing **(S2)**	**LOCTITE® 518**



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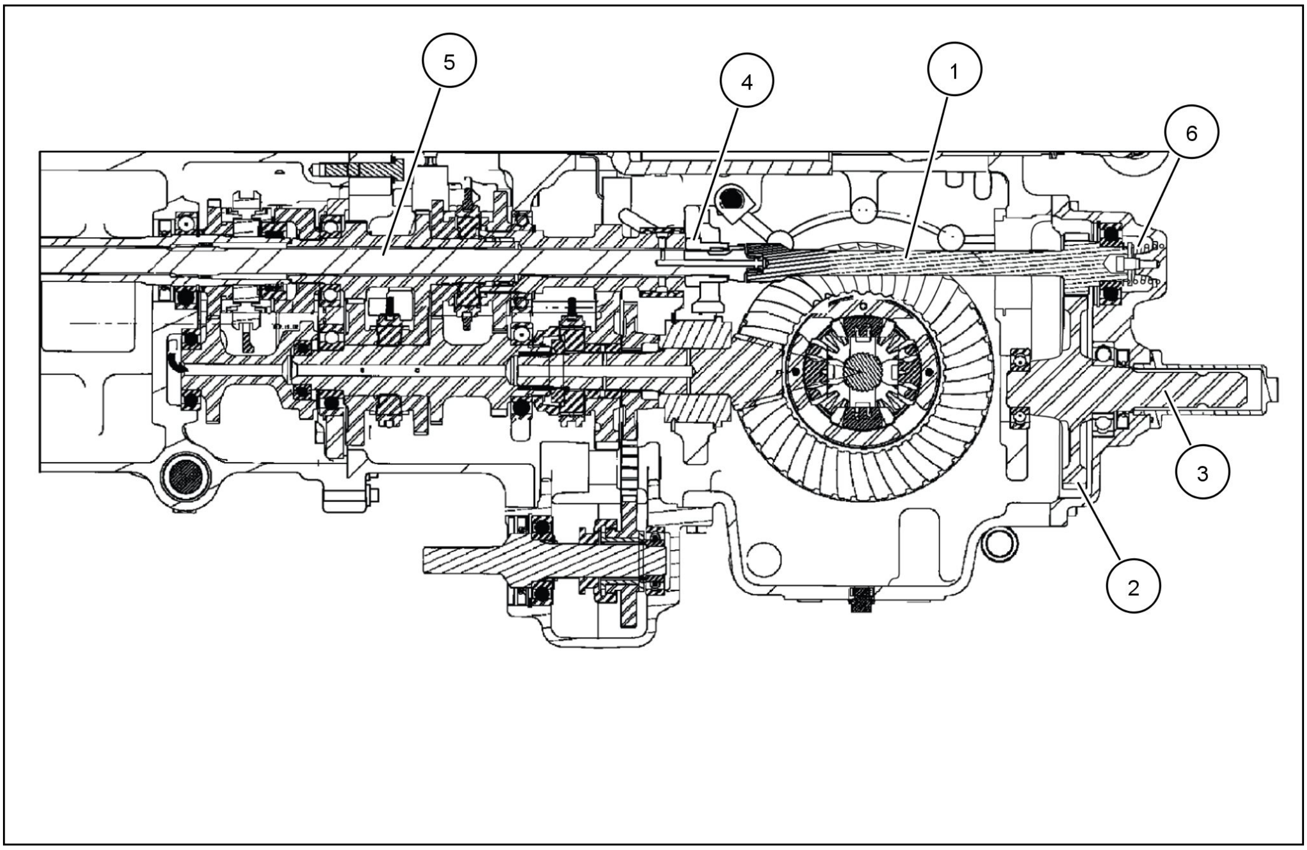
REAR PTO Mechanical - Sectional view



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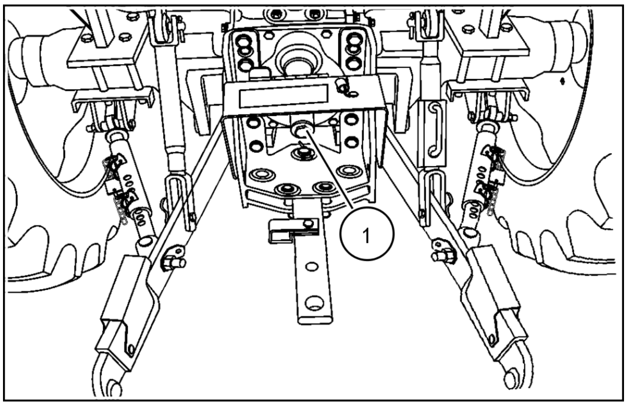
1. PTO input shaft
2. Reduction gear
3. PTO shaft
4. PTO engaging sleeve
5. Transmission input shaft
6. PTO Brake

REAR PTO Mechanical - Static description

The power take-off (PTO) transfers engine power directly to mounted or trailed equipment through a splined shaft, **(1)**, at the rear of the tractor.



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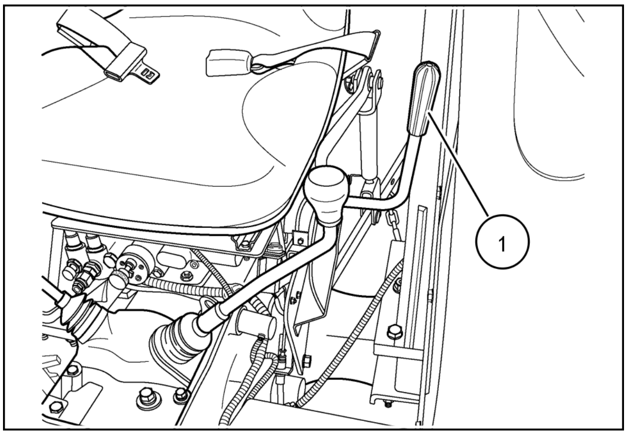
The PTO system is independent, that is, the PTO may be engaged or disengaged whether the tractor is moving or stationary. Rotation of the PTO shaft is not affected by the main clutch and tractor speed but is related directly to the speed of the engine.

The PTO system utilizes the standard 6-spline shaft designed to operator at **540 RPM**, with a clockwise rotation, as viewed from the rear of the tractor.

The standard speed of **540 RPM** is obtained at engine **1747 RPM**.

The PTO is engaged or disengaged by means of lever, **(1)**.



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⚠ **DANGER** ⚠

To avoid inadvertent movement of the implement, disengage the PTO after each use. Failure to comply could result in death or serious injury.

B014

⚠ **WARNING** ⚠

Whenever operating PTO equipment, observe the following precautions:

- Check that you are using the correct PTO speed for the implement. Follow the operator's instructions in the Operator's Manual.

- Make sure that the PTO guard is installed when using PTO driven equipment

- DO NOT wear loose clothing when operating PTO driven equipment.

- Firmly apply the parking brake, place all control levers in the neutral position and block all four wheels before operating any stationary PTO equipment.

- DO NOT approach, clean or adjust PTO driven equipment while the engine is still running. Stop the engine and remove the key, wait until the PTO and the equipment stop turning before leaving the machine or before working on the PTO, or the equipment.

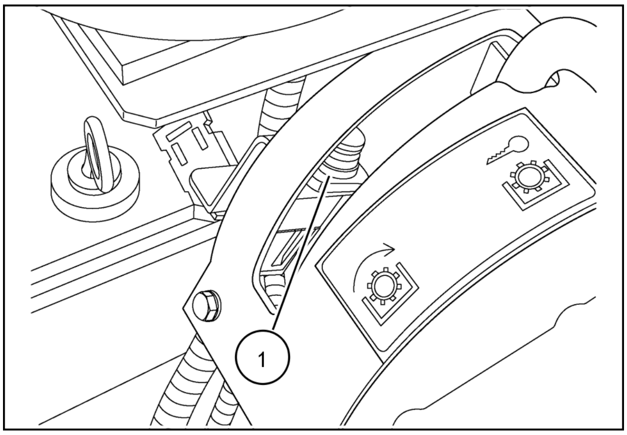
- With the engine stopped and key removed, the PTO brake is released and the shaft may be turned by hand to assist in the installation or removal of the implement shaft.

Failure to comply could result in death or serious injury.

M1422

Sensing system - Static description PTO Safety switch

The PTO safety switch, **(1)**, is a double pole, single throw-style switch located on the PTO control lever quadrant. The switch has a rubber booted push button actuator and is activated by the PTO clutch lever. When the PTO clutch lever is in the "OFF" position, the switch button is "OUT" when the PTO clutch is engaged the switch button is in the "IN" position.



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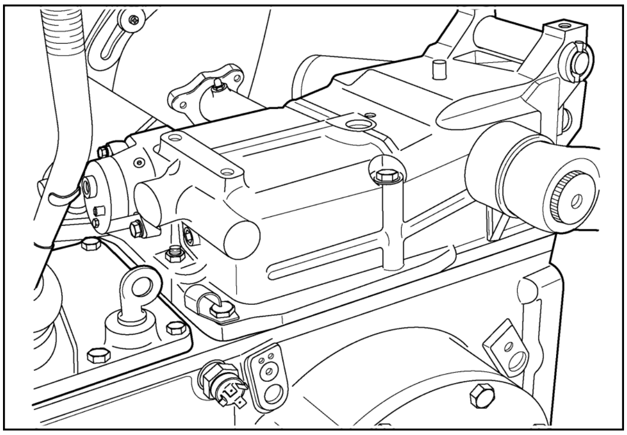
REAR PTO Mechanical - Remove Main PTO Levers and Internal Linkages

⚠ WARNING ⚠

Handle all parts carefully. Do not put your hands or fingers between parts. Always wear suitable safety items such as fitted clothing, safety goggles, gloves, shoes, etc. Failure to comply could result in death or serious injury.

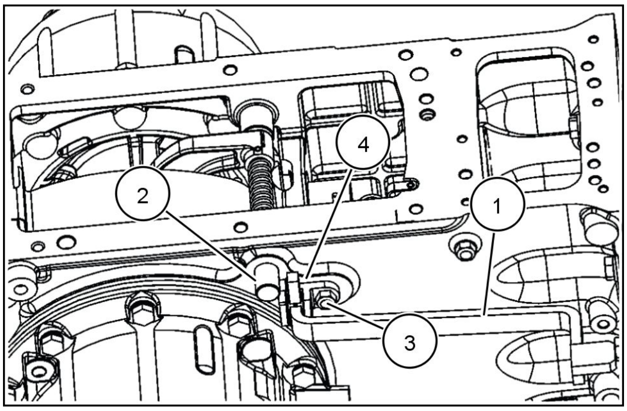
M954A

1. Remove the hydraulic lift assembly as described in **PRIMARY HYDRAULIC POWER SYSTEM - Remove (A.10.A)**.



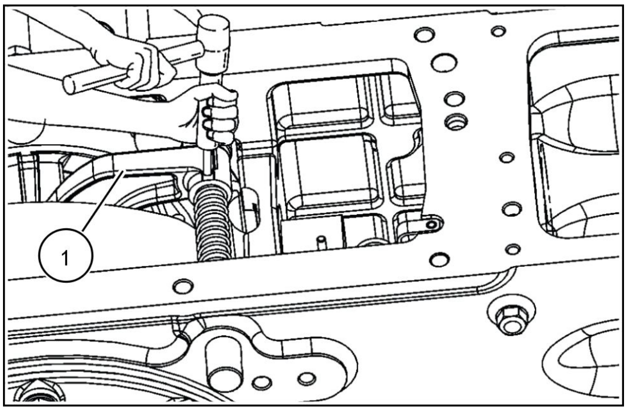
86065628 1

2. Press the differential pedal lever, **(1)**, by applying some force with hand to pull out the differential lock fork shaft, **(2)**. Remove the differential pedal lever, **(1)**, by unscrewing the bolt, **(3)**, securing the bracket, **(4)**.



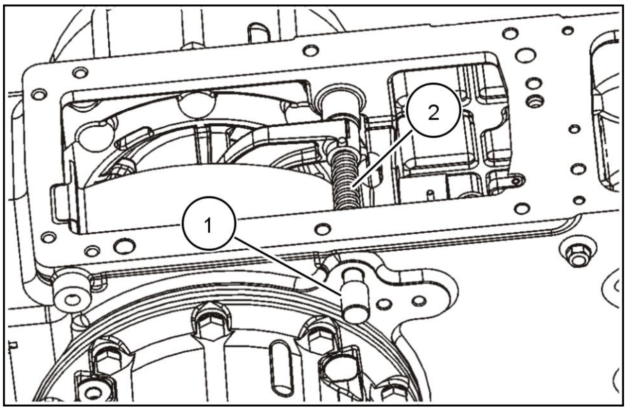
20103038 2

3. Remove the roll pin holding the differential lock fork, **(1)**.



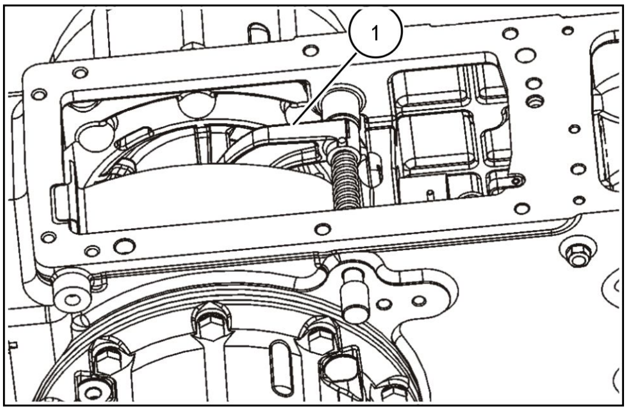
20103039 3

4. Remove the differential lock fork shaft, **(1)**, and carefully retrieve the loaded spring, **(2)**.



20103041 4

5. Remove the differential lock pedal fork, **(1)**.



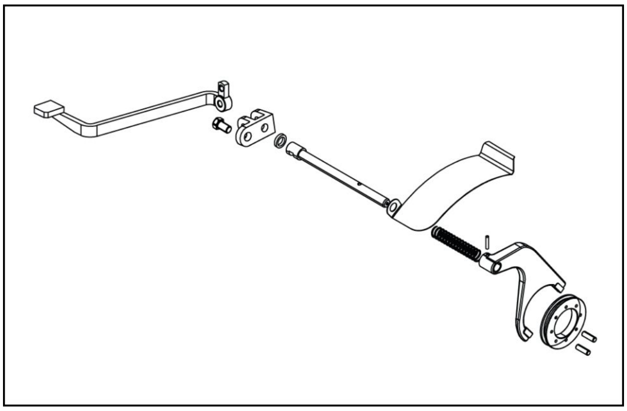
20103041 5

Next operation:
REAR PTO Mechanical - Inspect Main PTO Levers and Internal Linkages (C.40.B)

REAR PTO Mechanical - Inspect Main PTO Levers and Internal Linkages

Prior operation:
REAR PTO Mechanical - Remove Main PTO Levers and Internal Linkages (C.40.B)

1. Check the forks and shafts for any kinds of damage. Replace components as necessary.



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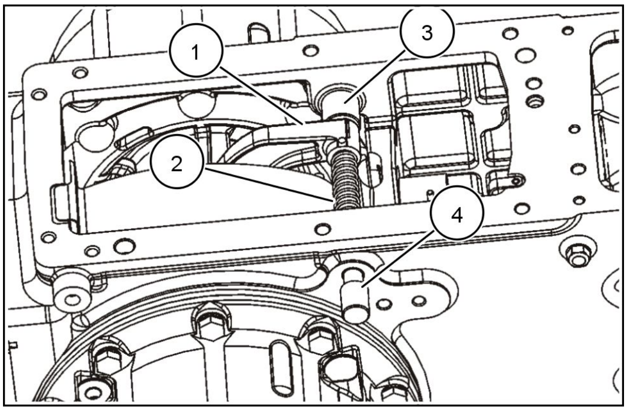
Next operation:
REAR PTO Mechanical - Install Main PTO Levers and Internal Linkages (C.40.B)

REAR PTO Mechanical - Install Main PTO Levers and Internal Linkages

Prior operation:
REAR PTO Mechanical - Inspect Main PTO Levers and Internal Linkages (C.40.B)

1. Install the differential lock pedal fork, **(1)**. Install the spring, **(2)**, on the inner shaft, **(3)**, and position it against the differential lock pedal fork, **(1)**.
2. Install the differential lock fork shaft, **(4)**, until the roll pin holes are aligned.



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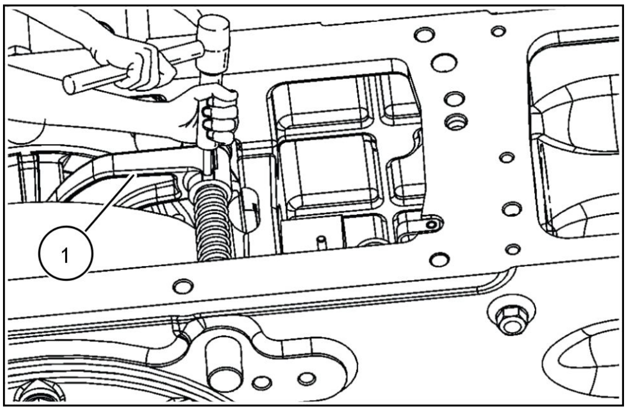
3. Install the roll pin holding the differential lock fork, **(1)**.



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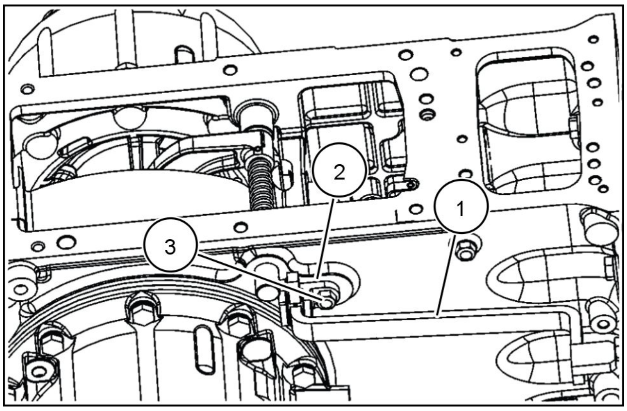
4. Install the differential lock pedal, **(1)**, and secure the bracket, **(2)**, with bolt, **(3)**. Torque the hardware to **52 N·m** (**38 lb ft**)



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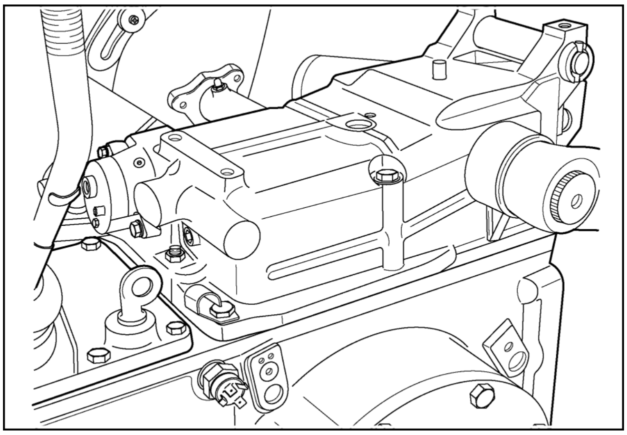
5. Install the hydraulic lift assembly as described in **PRIMARY HYDRAULIC POWER SYSTEM - Install (A.10.A)**.

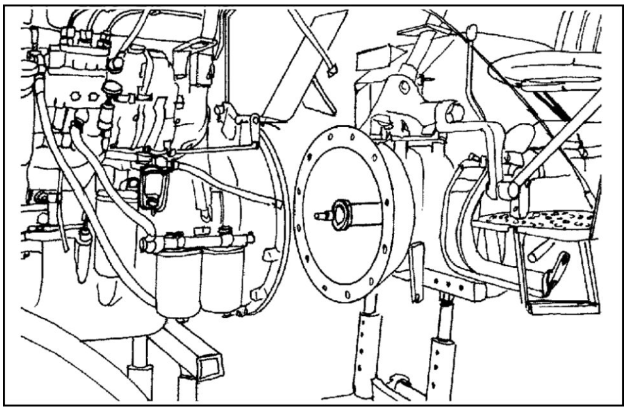


86065628 4

Next operation:
Shaft - Remove Main PTO Shafts (C.40.B)

Clutch command - Remove PTO and Clutch lever cross shaft

1. Remove the front reduction gearbox from the engine as described in **ENGINE - Remove (B.10.A)**.



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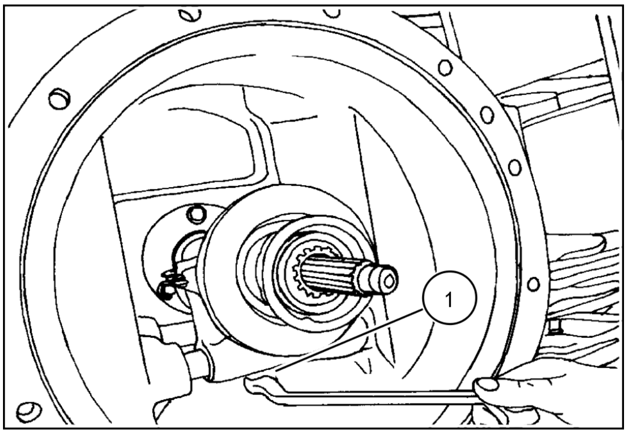
2. Remove the set screw, **(1)**.



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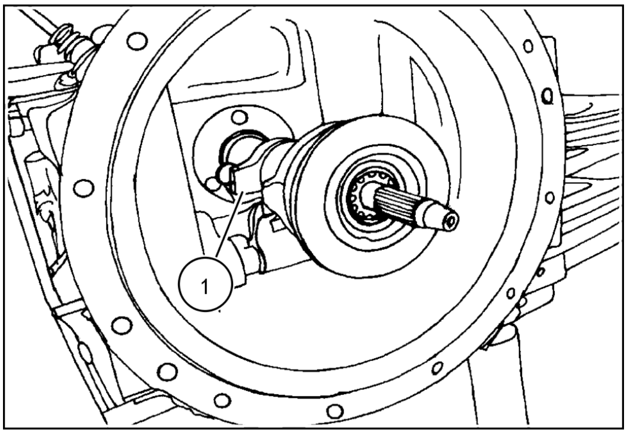
3. Remove the release bearing lock, **(1)**.



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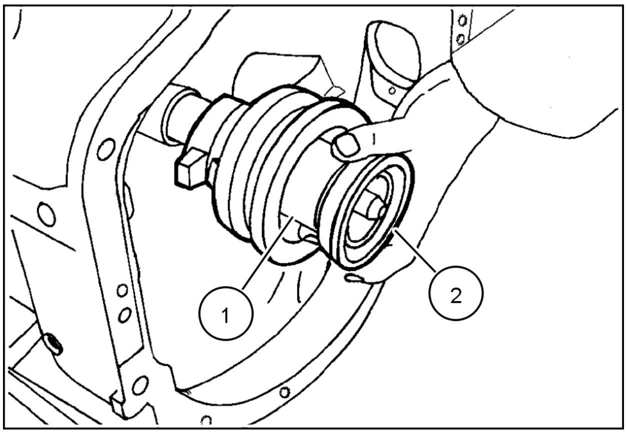
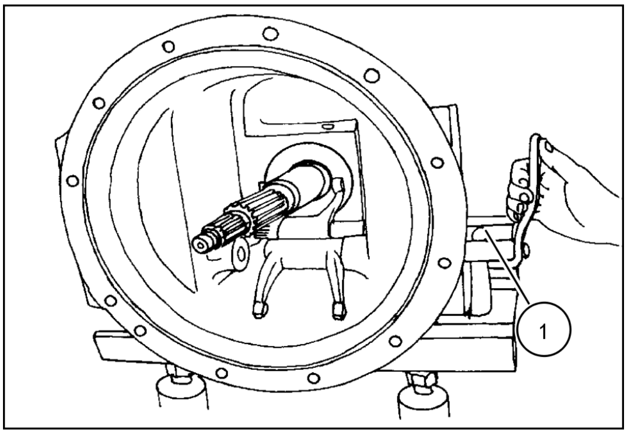
4. Remove the clutch release bearing, **(1)** and **(2)**.



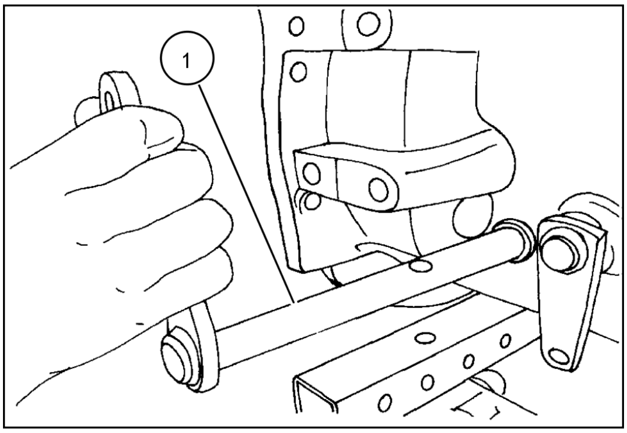
20097515 4

5. Remove the PTO clutch cross shaft, **(1)**. Remove the cross shaft fork.



20097516 5

6. Remove the main clutch cross shaft, **(1)**. Remove the main clutch cross shaft fork, not shown.



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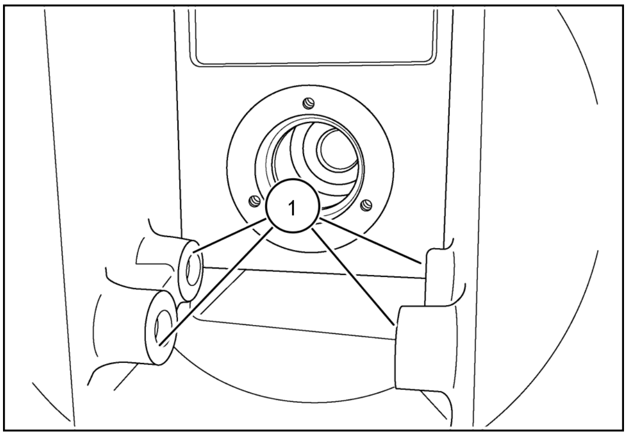
Next operation:
Clutch command - Inspect PTO and Clutch lever cross shaft (C.40.B)

Clutch command - Inspect PTO and Clutch lever cross shaft

Prior operation:
Clutch command - Remove PTO and Clutch lever cross shaft (C.40.B)

1. Inspect the cross shafts and forks (not shown) for abnormal wear and replace as needed.
2. Inspect the cross shaft bushings, **(1)**, located in the front reduction gearbox housing. Replace as needed using a suitable bushing tool.

NOTE: *Several components are removed for clarity.*



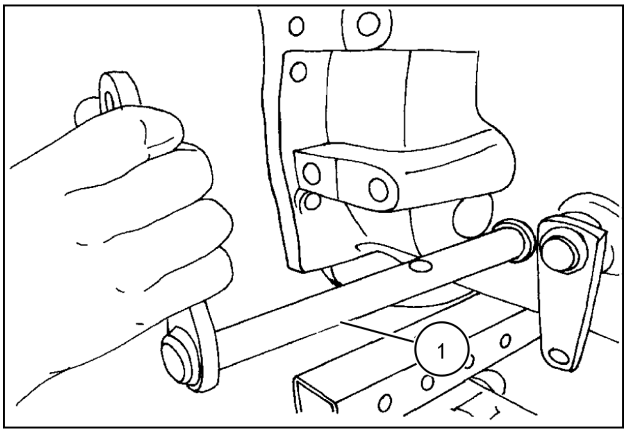
86065980 1

Next operation:
Clutch command - Install PTO and Clutch lever cross shaft (C.40.B)

Clutch command - Install PTO and Clutch lever cross shaft

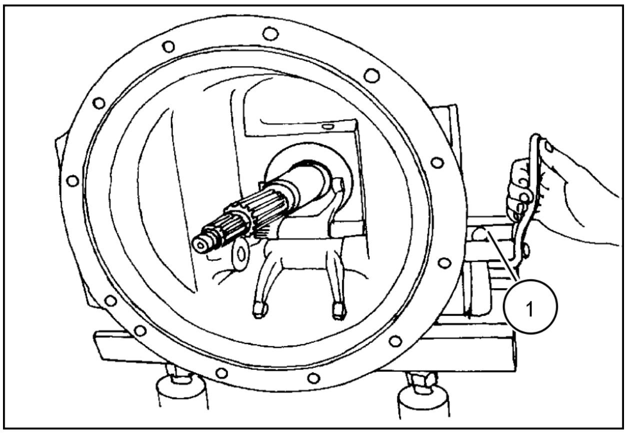
Prior operation:
Clutch command - Inspect PTO and Clutch lever cross shaft (C.40.B)

1. Install the main clutch cross shaft, **(1)**, through the housing and engage into the main clutch cross shaft fork, not shown.



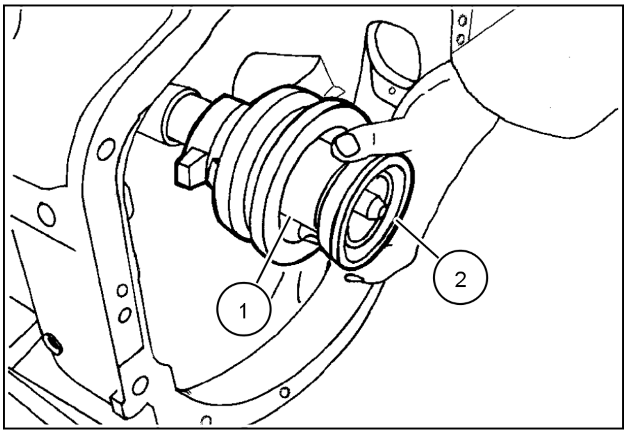
20097517 1

2. Install the PTO clutch cross shaft, **(1)**, and engage into the cross shaft fork, not shown.



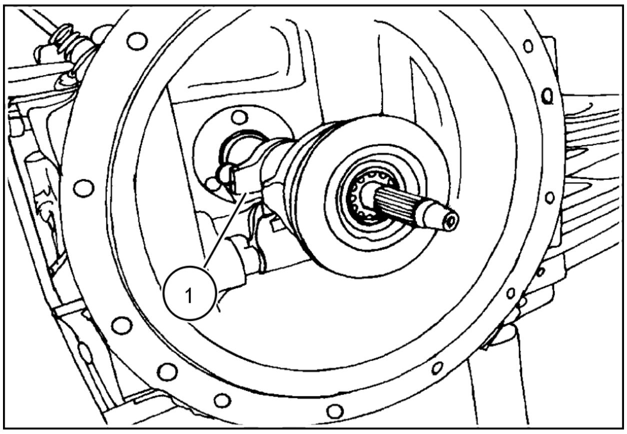
20097516 2

3. Install the clutch release bearing, **(1)** and **(2)**.



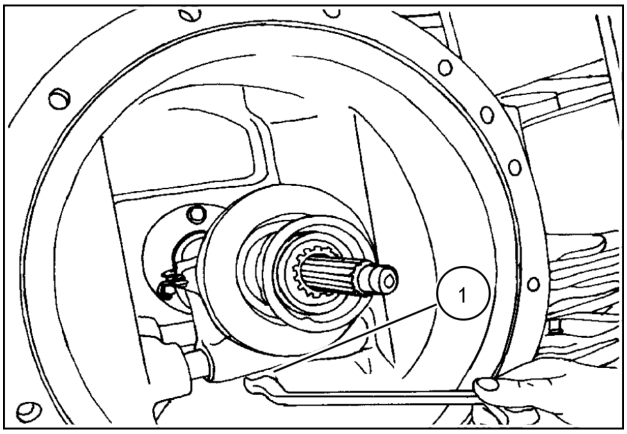
20097515 3

4. Install the release bearing lock, **(1)**.



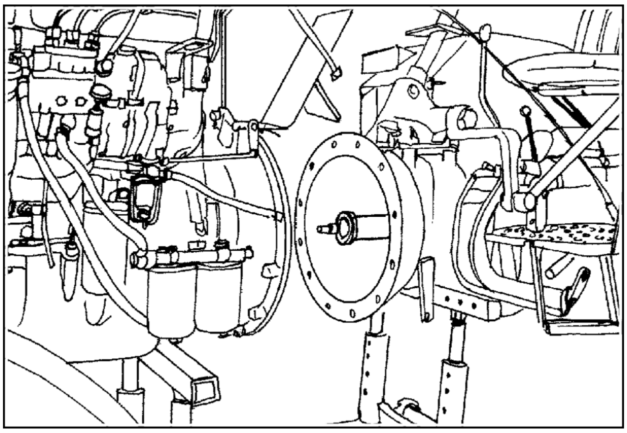
20097514 4

5. Install the set screw, **(1)**. Torque the set screw to **68 N·m** (**50 lb ft**).



20097513 5

6. Install the front reduction gearbox to the engine as described in **ENGINE - Install (B.10.A)**.

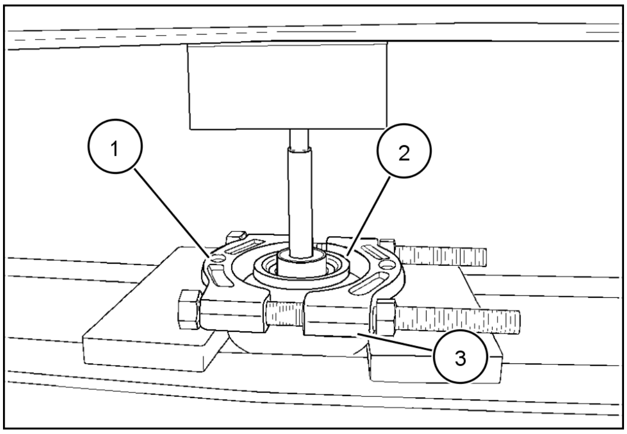


20097512 6

Next operation:
Clutch command - Disassemble Transmission/PTO Release Bearing Assembly (C.40.B)

Clutch command - Disassemble Transmission/PTO Release Bearing Assembly

1. Insert bearing puller, **(1)**, in between upper bearing, **(2)** and the master clutch sleeve assembly, **(3)**.
2. Press master clutch sleeve, **(3)**, from the bearing.

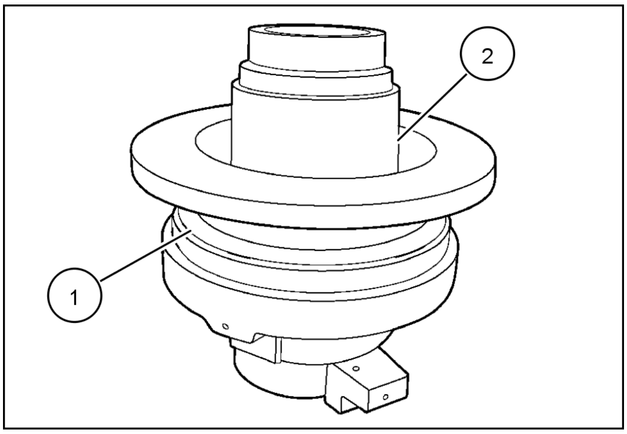


20097518 1

3. Remove the PTO Clutch bearing with sleeve, **(1)**, from master clutch sleeve, **(2)**.

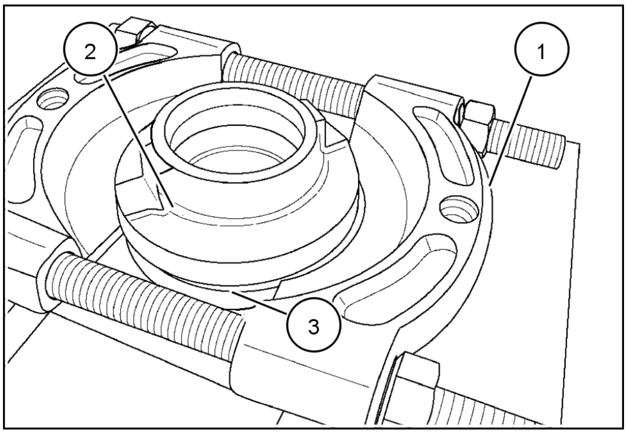
NOTE: *Bearing and PTO clutch sleeve are serviced together. Make sure to order the bearing and the PTO clutch sleeve when servicing.*

4. Inspect master clutch sleeve, **(2)**, for wear and/or damage and replace as needed.



20097519 2

5. Insert tool, **(1)**, in between bearing housing, **(2)** and the collar sleeve, **(3)**.
6. Press collar sleeve, **(3)**, from the bearing.



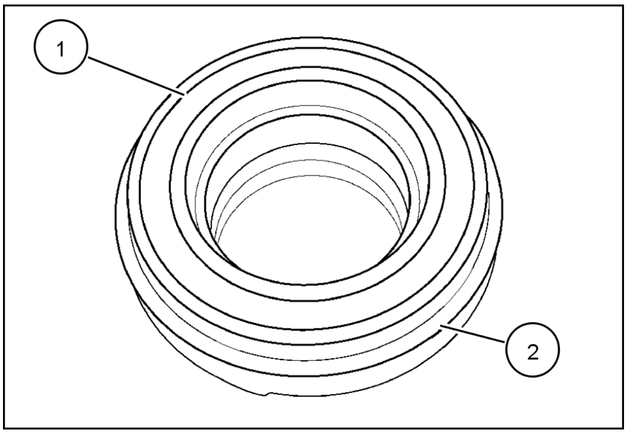
20097520 3

Next operation:
Clutch command - Assemble Transmission/PTO Release Bearing Assembly (C.40.B)

Clutch command - Assemble Transmission/PTO Release Bearing Assembly

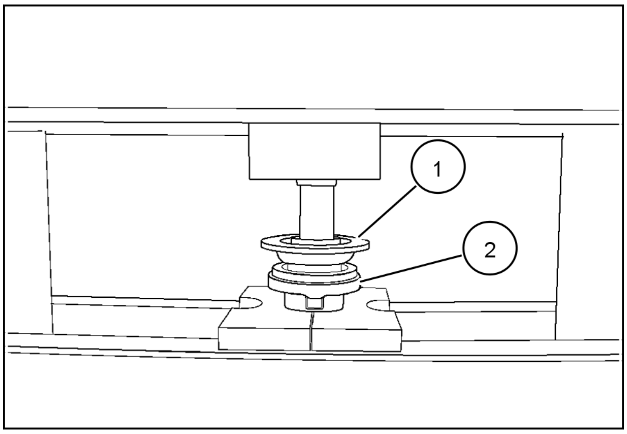
Prior operation:
Clutch command - Disassemble Transmission/PTO Release Bearing Assembly (C.40.B)

1. Insert new bearing, **(1)**, into new PTO clutch sleeve, **(2)**.



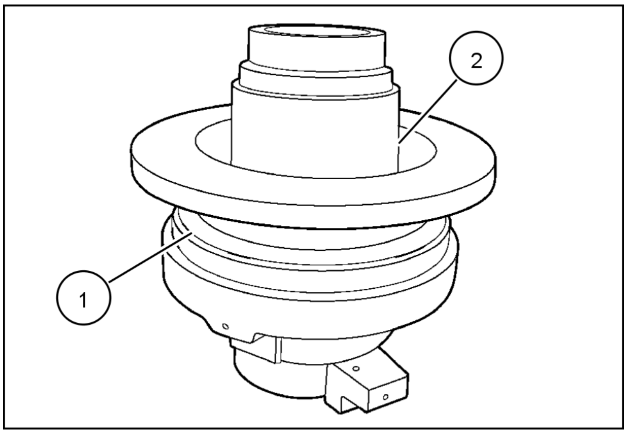
20097521 1

2. Press collar sleeve, **(1)**, into new bearing assembly, **(2)**.



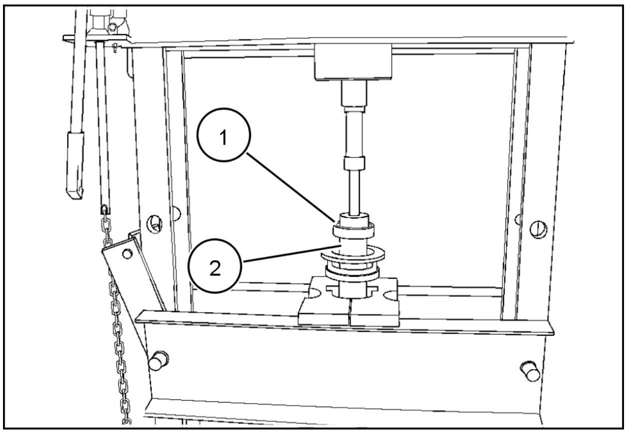
20097522 2

3. Install the PTO Clutch bearing with sleeve, **(1)**, onto housing, **(2)**.



20097519 3

4. Press new release main clutch bearing, **(1)**, onto master clutch sleeve, **(2)**.

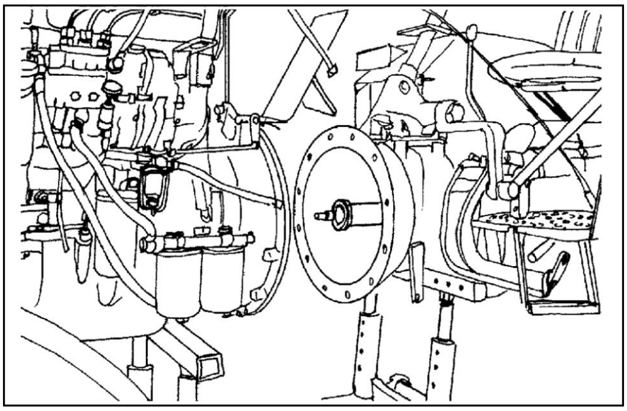


20097523 4

Next operation:
POWER COUPLING Clutch - Remove Clutch Assembly (C.10.C)

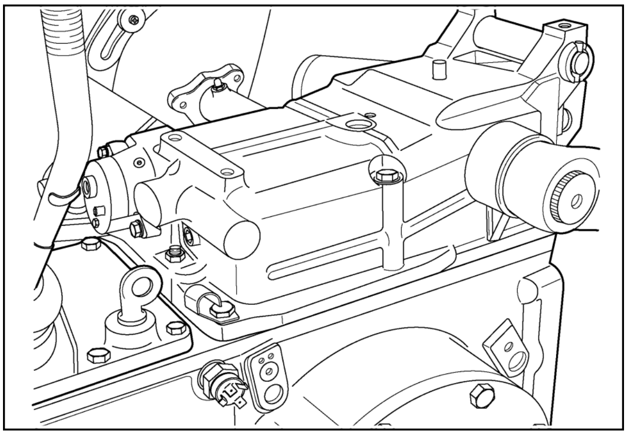
Shaft - Remove Main PTO Shafts

1. Separate the engine from the transmission as described in **ENGINE - Remove (B.10.A)**.



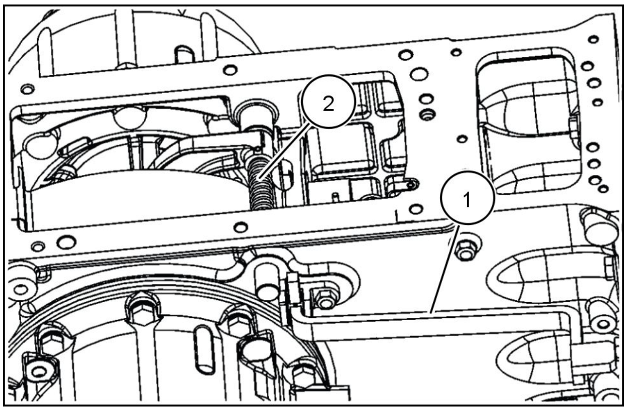
20103035 1

2. Remove the hydraulic lift assembly as described in **PRIMARY HYDRAULIC POWER SYSTEM - Remove (A.10.A)**.



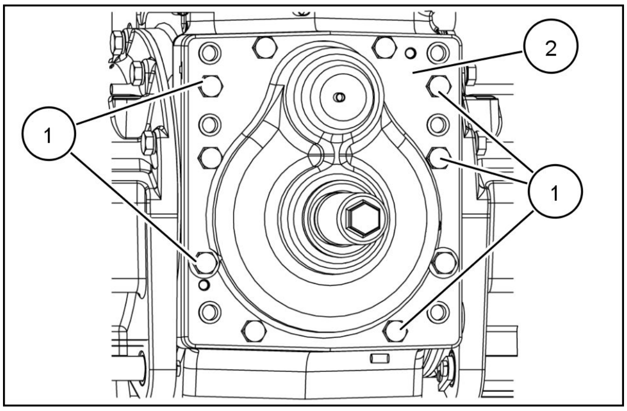
86065628 2

3. Remove the differential lock pedal, **(1)**, and the internal components, **(2)**, as described in **REAR PTO Mechanical - Remove Main PTO Levers and Internal Linkages (C.40.B)**.



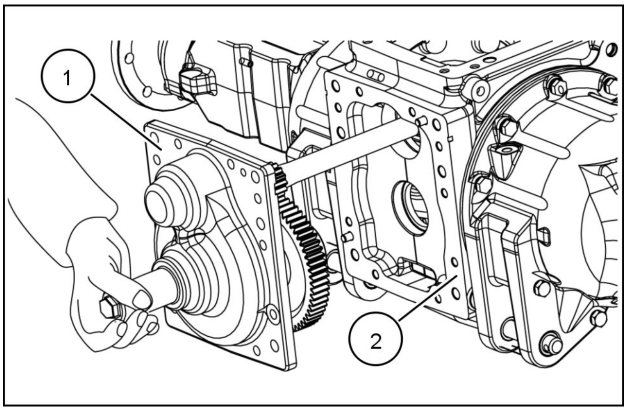
20103038 3

4. Loosen the bolts, **(1)**, securing PTO rear cover, **(2)**, to the differential housing.



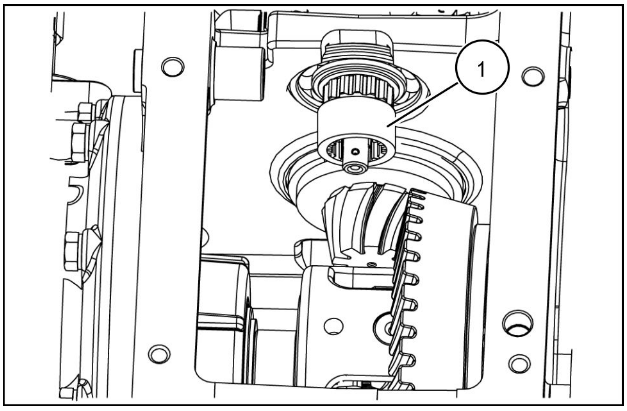
200900310 4

5. Remove the PTO shaft assembly, **(1)**, from the housing, **(2)**.



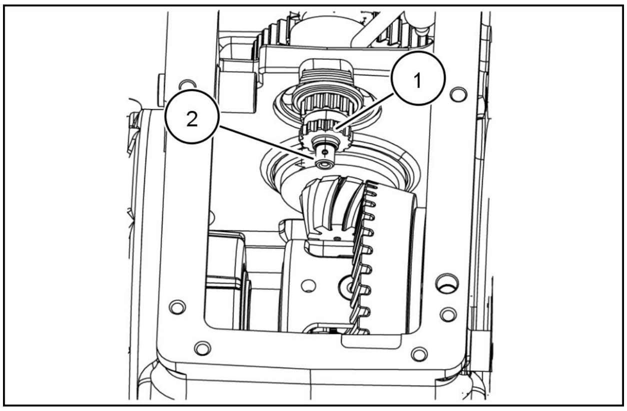
200900303 5

6. Remove the PTO coupler, **(1)**.



200900304 6

7. Remove the PTO coupler gear, **(1)**.
8. Remove the PTO shaft, **(2)**, by tapping on the rear of the shaft, (not shown) with a rubber mallet and pulling from the front of the shaft.



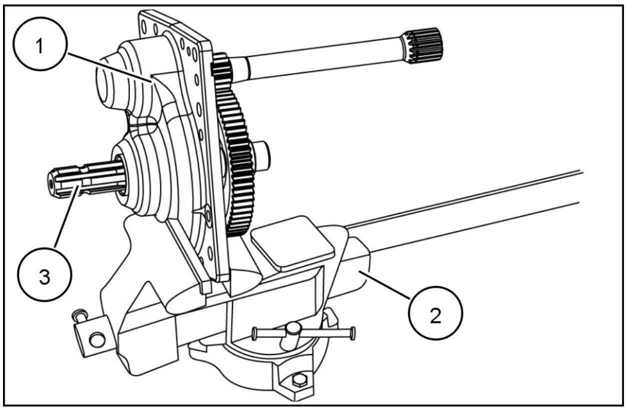
200900309 7

Next operation:
Shaft - Disassemble Rear PTO Shaft Assembly (C.40.B)

Shaft - Disassemble Rear PTO Shaft Assembly

Prior operation:
Shaft - Remove Main PTO Shafts (C.40.B)

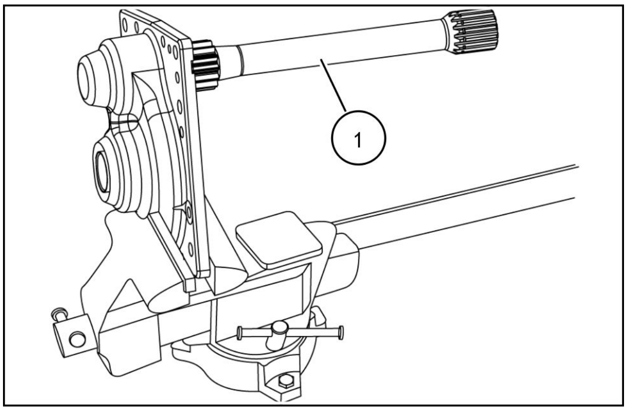
1. Insert the PTO cover assembly, **(1)**, into a suitable bench vise, **(2)**.
2. Remove the PTO shaft from the cover by hitting the end of the PTO shaft, **(3)**, with a rubber hammer.



200900306 1

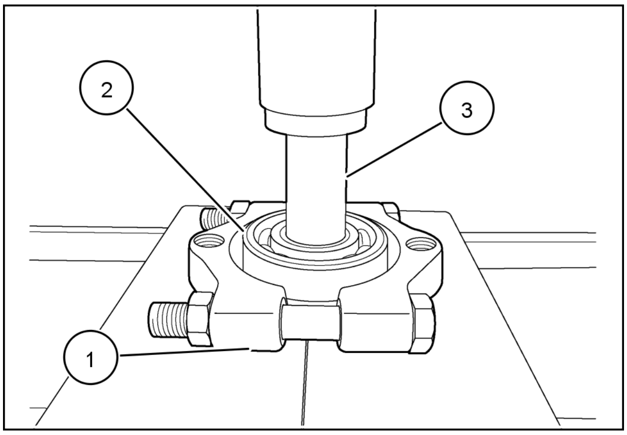
3. Remove the secondary PTO shaft, **(1)**.

NOTE: *Make sure not to damage the teeth of the gears.*



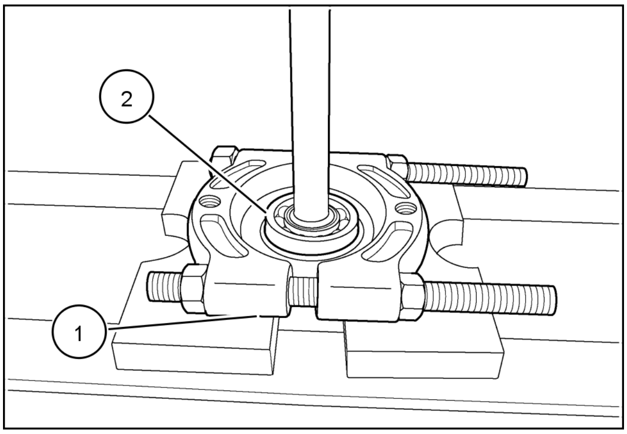
200900305 2

4. Using a suitable tool, **(1)**, brace the secondary PTO shaft bearing, **(2)**, and place the components in a suitable press.
5. While holding the secondary PTO shaft, (not shown), press the shaft through the bearing with an adaptor, **(3)**, slightly smaller than the shaft diameter.



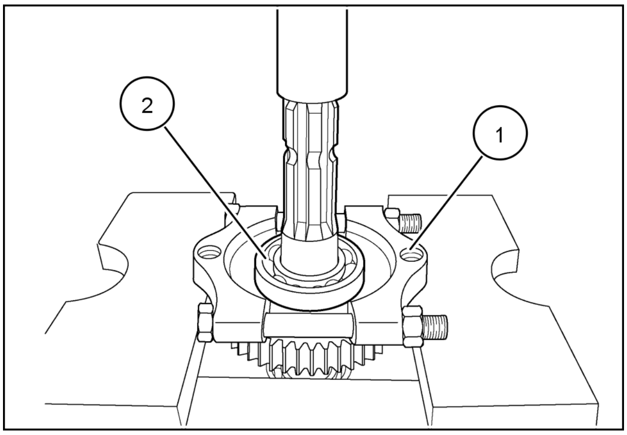
86066005 3

6. Using a suitable tool, **(1)**, brace the PTO shaft inner bearing (with retaining ring), **(2)**, and place the components into a suitable press.
7. While holding the PTO shaft assembly, (not shown), press the shaft assembly through the bearing.



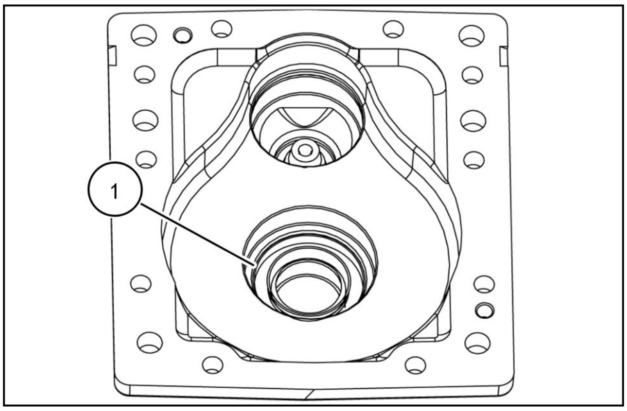
86066006 4

8. Using a suitable tool, **(1)**, brace the PTO shaft outer bearing, **(2)**, and place the components into a suitable press.
9. While holding the PTO shaft assembly, (not shown), press the shaft assembly through the bearing.



86066007 5

10. Using a suitable seal removing tool, remove the PTO shaft seal, **(1)**, from the PTO cover.



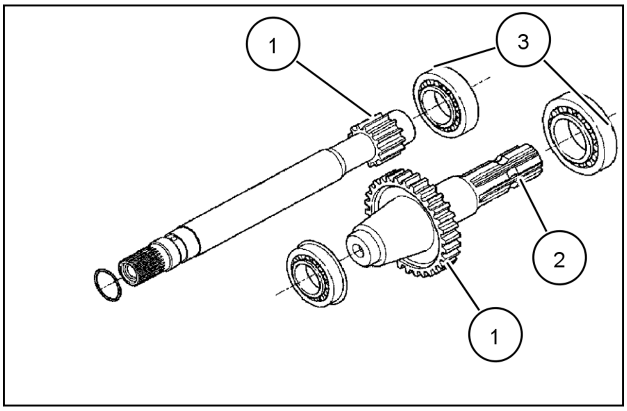
200900307 6

Next operation:
Shaft - Inspect Rear PTO Shaft Assembly (C.40.B)

Shaft - Inspect Rear PTO Shaft Assembly

Prior operation:
Shaft - Disassemble Rear PTO Shaft Assembly (C.40.B)

1. Check the gears, **(1)**, shafts, **(2)**, and bearings, **(3)**, for wear and damage. Replace the components as required.



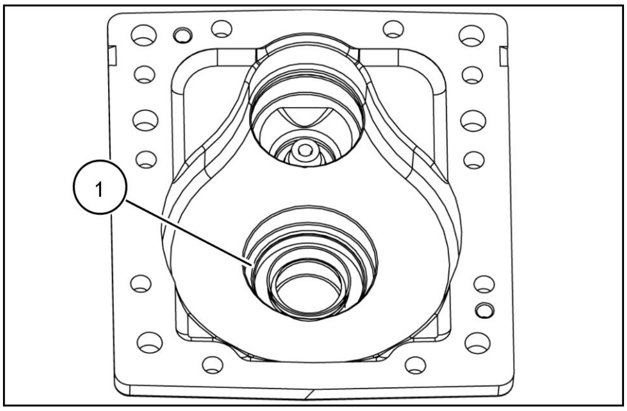
200900313 1

Next operation:
Shaft - Assemble Rear PTO Shaft Assembly (C.40.B)

Shaft - Assemble Rear PTO Shaft Assembly

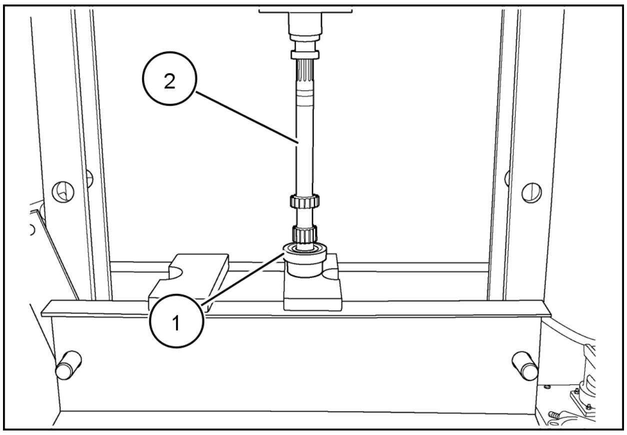
Prior operation:
Shaft - Inspect Rear PTO Shaft Assembly (C.40.B)

1. Using a suitable seal installing tool, install the PTO shaft seal, **(1)**, in the PTO cover.



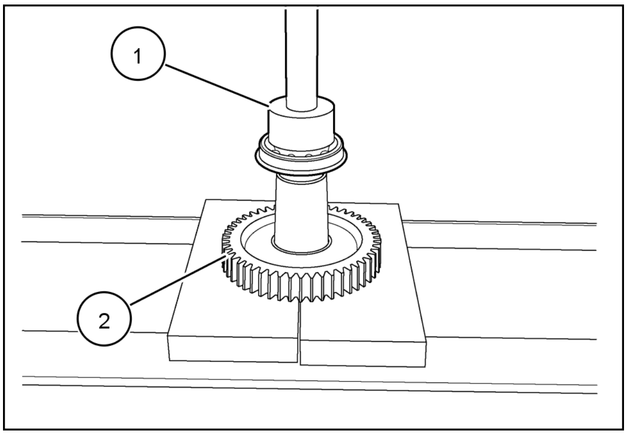
200900307 1

2. Install the bearing, **(1)**, onto the secondary PTO shaft, **(2)**, with a suitable press, as shown.
3. Apply force to the shaft until the bearing is completely seated against the shaft.



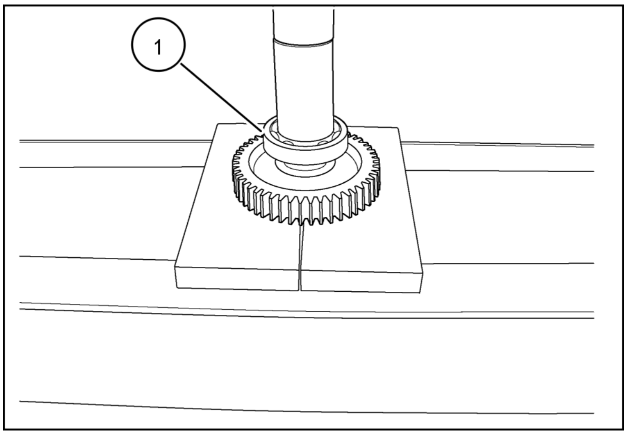
86066012 2

4. Install the inner bearing, **(1)**, onto the PTO shaft with retaining ring facing the gear, **(2)**.



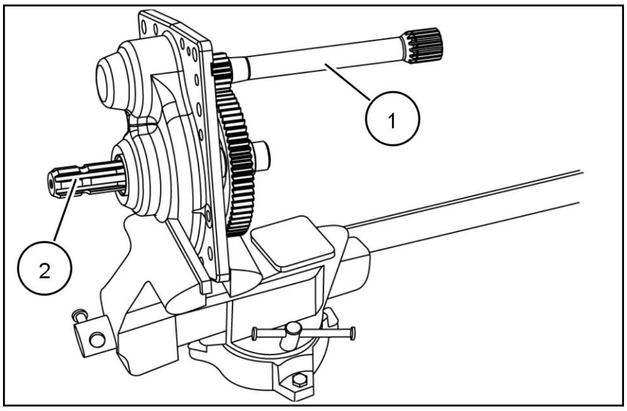
86066013 3

5. Install the outer bearing, **(1)**, onto the PTO shaft.



86066014 4

6. Install the secondary PTO shaft, **(1)**, into the cover with a rubber hammer until the bearing bottoms out in the PTO cover.
7. Install the PTO shaft, **(2)**, into the cover with a rubber hammer until the bearing bottoms out in the cover.



200900306 5

Next operation:
Shaft - Install Main PTO Shafts (C.40.B)

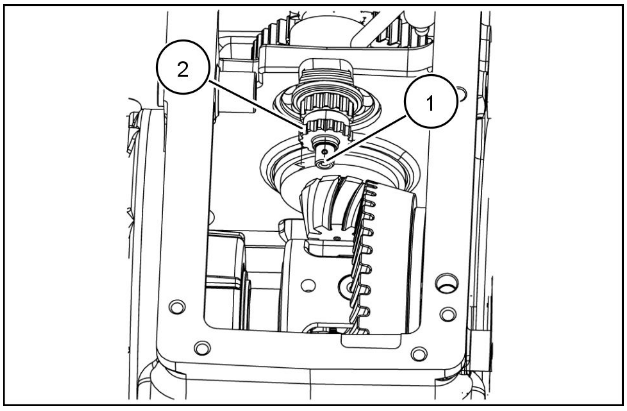
Shaft - Install Main PTO Shafts

Prior operation:
Shaft - Remove Main PTO Shafts (C.40.B)

1. Install the PTO shaft, **(1)**, into the transmission shaft, **(2)**.

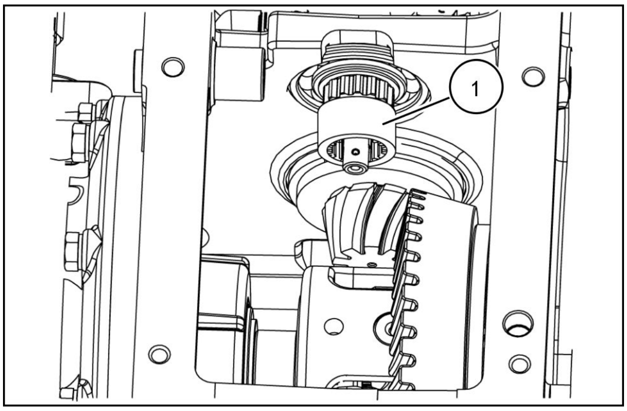
NOTE: *Be careful not to damage the shaft seal when installing the PTO shaft.*

2. Install the PTO coupler gear, **(2)**.



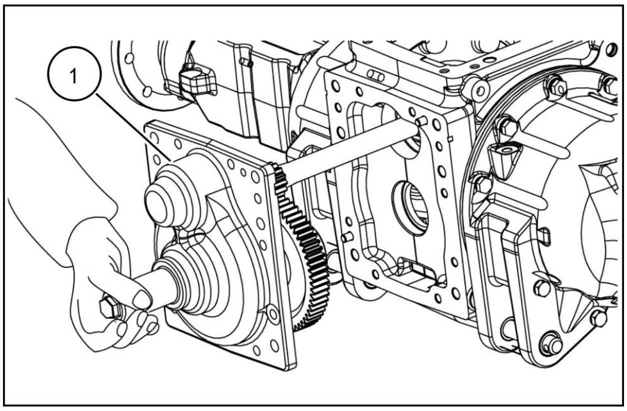
200900309 1

3. Install the PTO coupler, **(1)**.

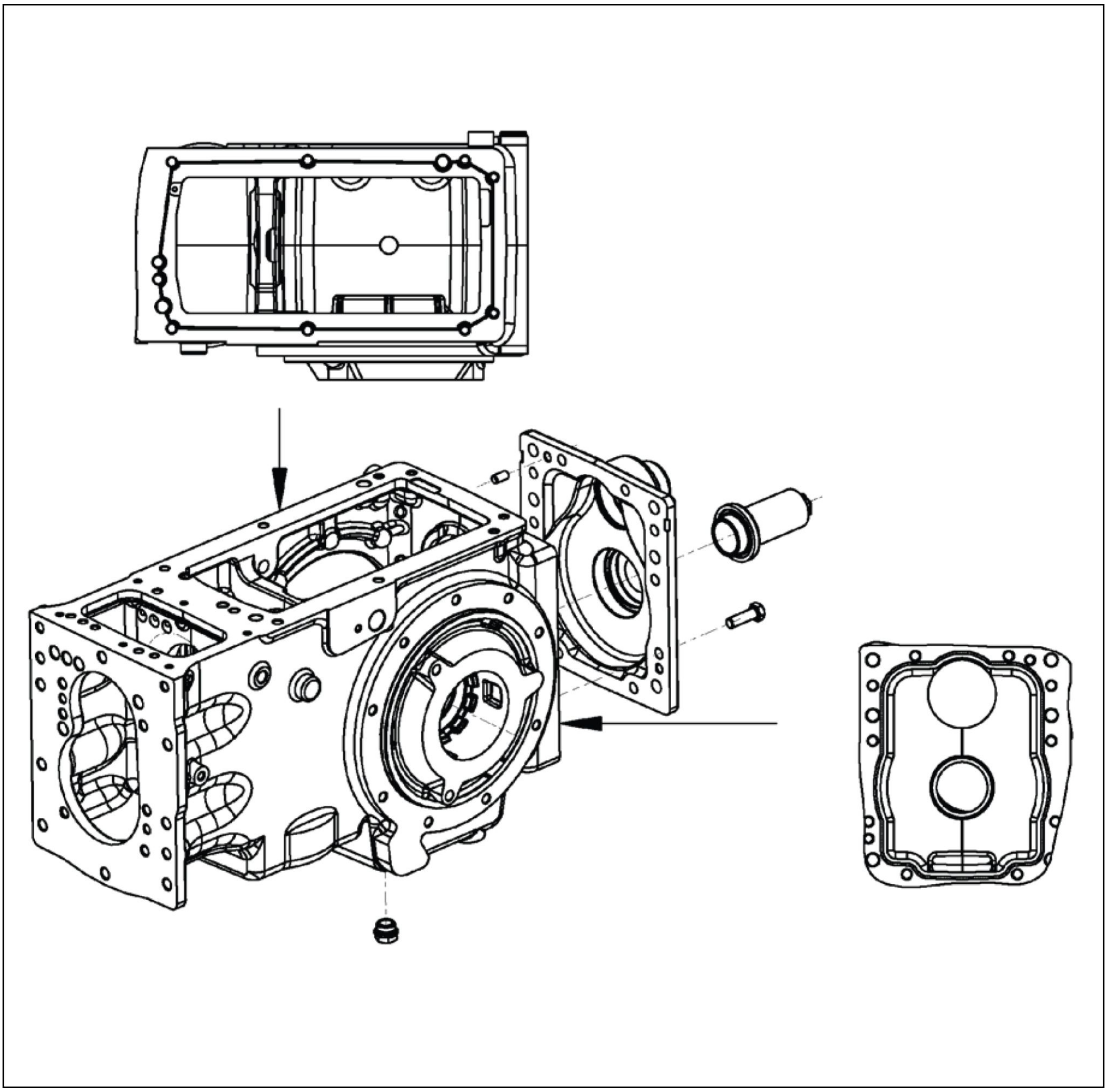


200900304 2

4. Before reassembling the PTO cover to the housing, thoroughly clean and degrease the mating surfaces and apply a **2 mm** (**0.1 in**) bead of **LOCTITE® 518** sealant following the pattern shown in figure **4.**
5. Install the PTO shaft assembly, **(1)**, into the housing.

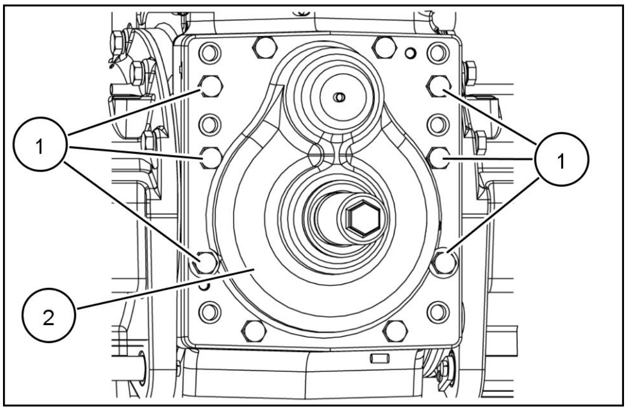


200900303 3



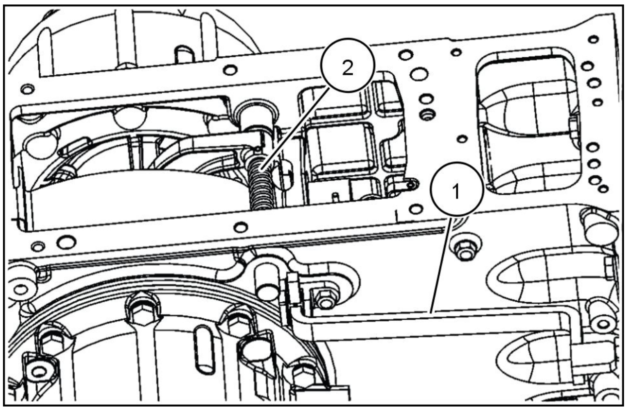
200900308 4

6. Install the bolts **(1)**, Securing the PTO rear cover, **(2)**, to the differential housing. Torque the retaining bolts to **50 N·m** (**37 lb ft**).



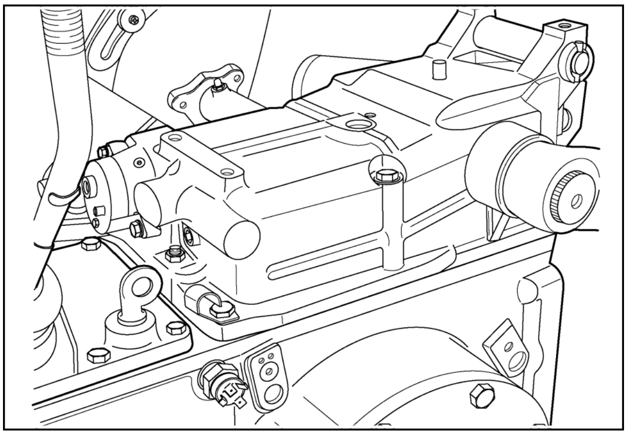
200900310 5

7. Install the differential lock pedal, **(1)**, and the internal components, **(2)**, as described in **REAR PTO Mechanical - Install (C.40.B)**.



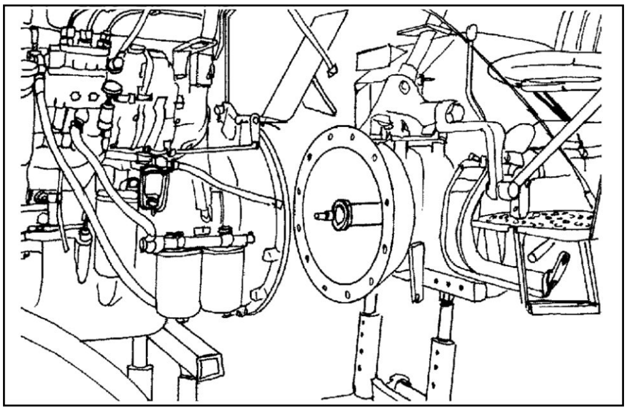
20103038 6

8. Install the hydraulic lift assembly as described in **PRIMARY HYDRAULIC POWER SYSTEM - Install (A.10.A)**.



86065628 7

9. Install the engine to the transmission as described in **ENGINE - Install (B.10.A)**.



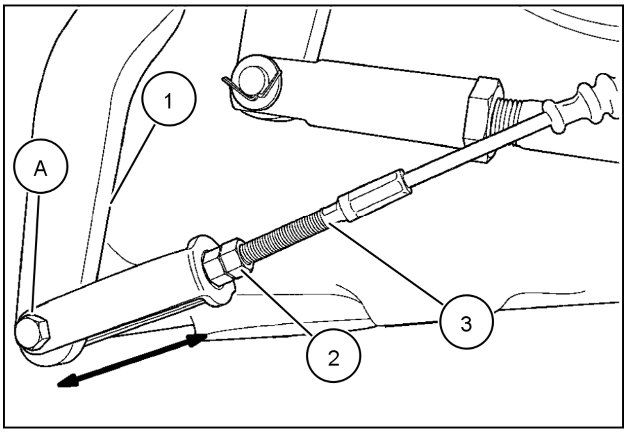
20103035 8

Clutch - Adjust PTO Clutch Adjustment

Prior operation:
Command - Adjust Clutch pedal setting (C.10.C)

NOTE: *The PTO clutch engagement pressure needs to be checked and adjusted to prevent slippage of the PTO clutch during operation under load.*

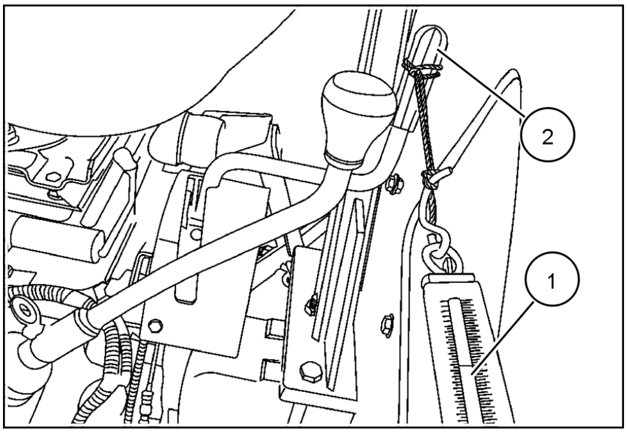
1. When PTO clutch linkage is properly adjusted, the PTO lever, **(1)**, should have **2 mm** (**0.08 in**)amount of free play measure at pin "A", when the PTO handle is in the "OFF" position.
2. If the free play of lever is not correct, adjust by loosening jamnut, **(2)**, and shortening or lengthening cable, **(3)**.



20097501 1

3. Use a spring scale, **(1)**, to measure the force needed to fully engage the PTO handle, **(2)**. Proper amount of force at end of handle to fully engage the PTO clutch is: **125 - 142 N** (**28 - 32 lb**).

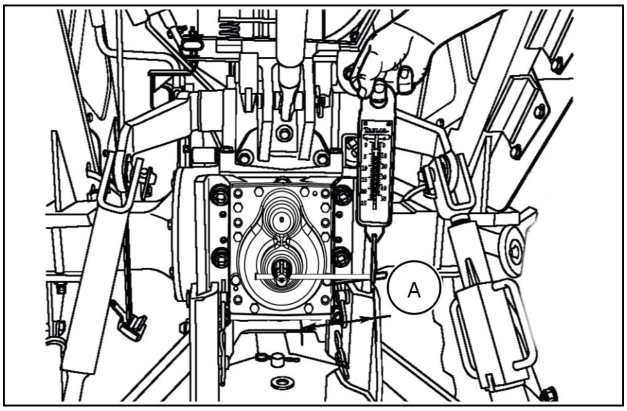
NOTE: *When PTO clutch linkage is properly adjusted, the total cable travel should be* ***21 mm*** *(**0.83 in**)while engaging and disengaging the PTO clutch.*



20097502 2

PTO brake - Test PTO Brake Torque Test

1. Place the tractor engine and PTO engagement lever both in the "OFF" position.
2. Insert a rod through the hole in the PTO shaft.
3. Attach a spring scale on the rod, 'A' - **110 mm** (**4.3 in**) from the outer diameter of the PTO shaft.
4. The force required to rotate the PTO shaft counter-clockwise is **6 - 8 kg** (**13 - 18 lb**).
5. If the force is not within the specification check PTO brake for wear or damage.



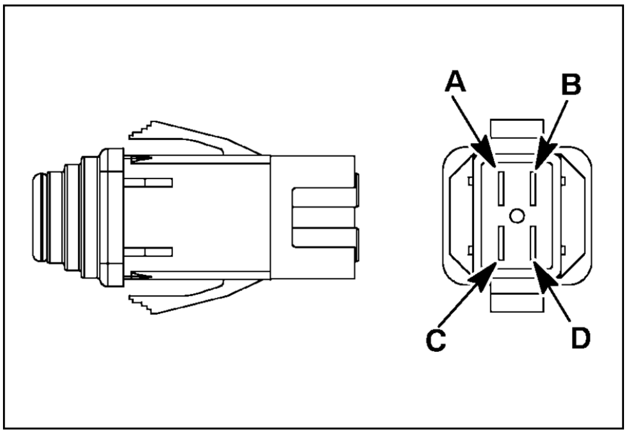
200900312 1

Sensing system - Test PTO Safety switch

Use an ohmmeter to test the rear PTO safety switch.

- With the button "OUT", there will be continuity across terminals "C" and "D".
- With the button "IN", there will be continuity across terminals "A" and "B".

NOTE: *If test results are not as outlined above, replace the rear PTO safety switch.*



20097561 1

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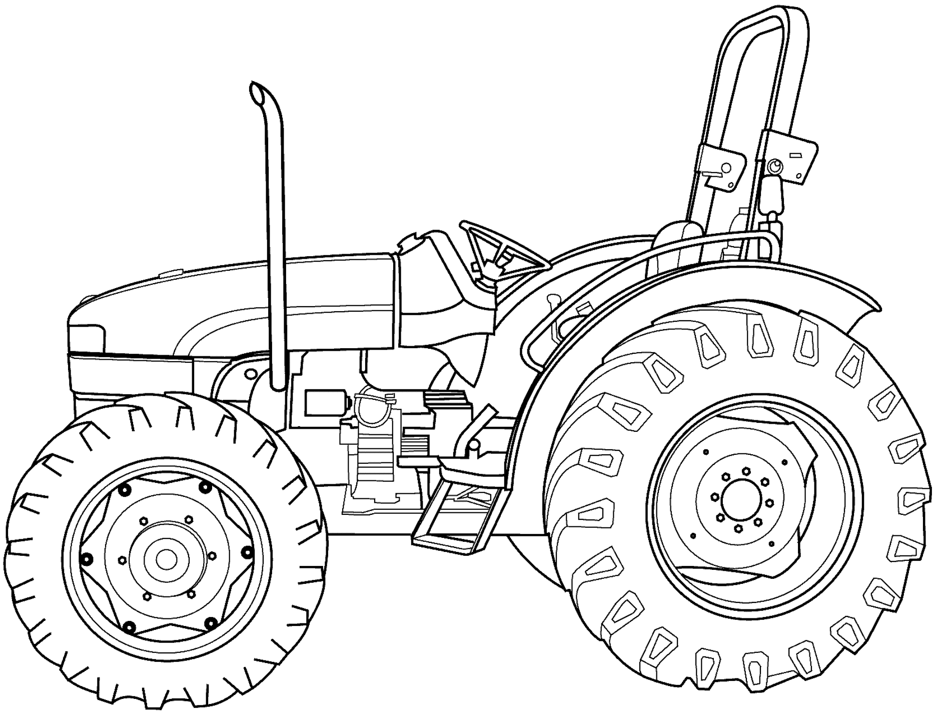
SERVICE MANUAL

AXLES, BRAKES AND STEERING



Workmaster 45
Workmaster 55

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AXLES, BRAKES AND STEERING - D

FRONT AXLE - 10.A

Workmaster 45
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FRONT AXLE

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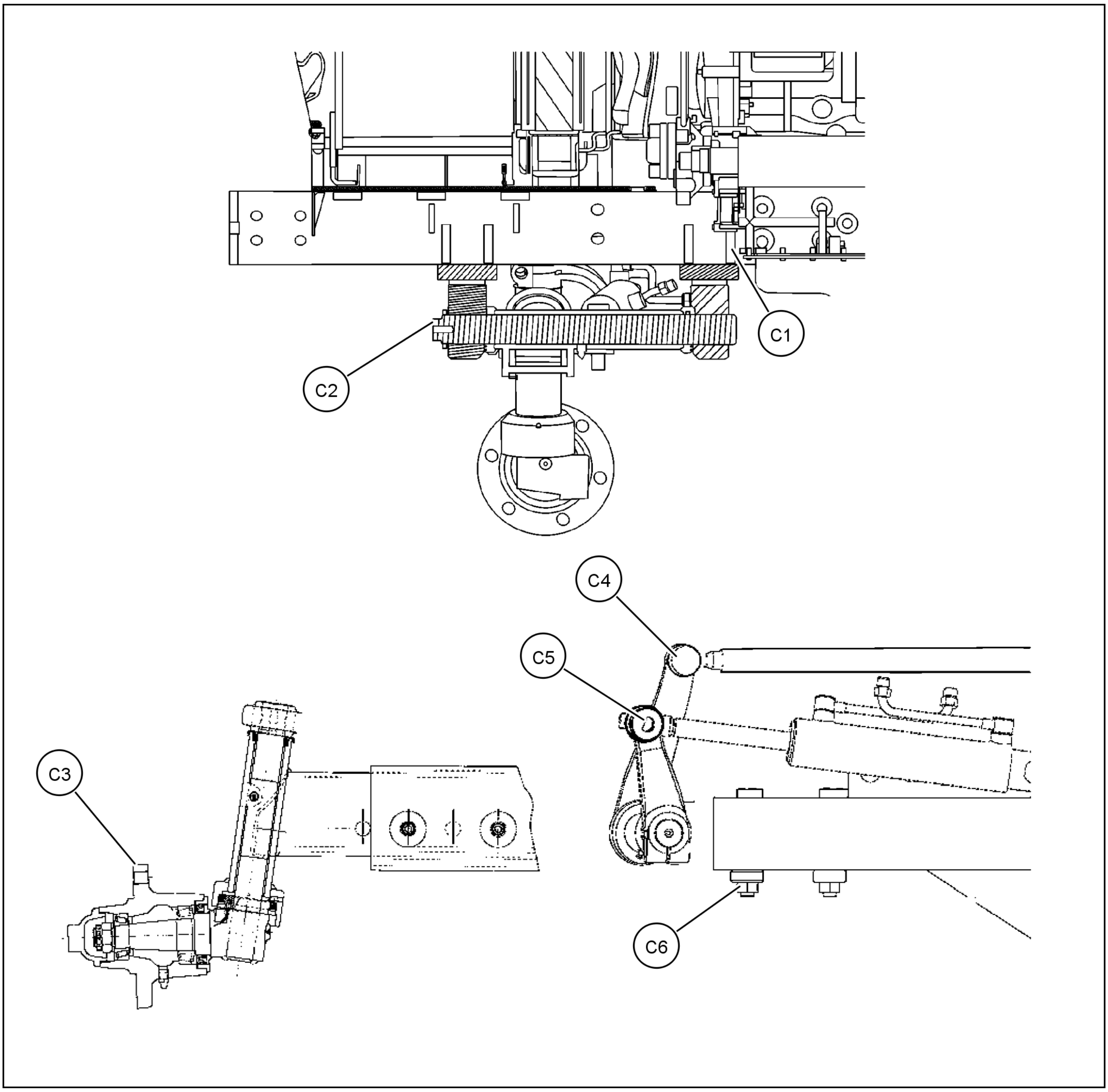
FRONT AXLE - General specification - 2WD

Type	Centrally pivoted U-type center beam with telescopic outer sections.
Track settings WORKMASTER 55	**1410 mm** (**55.5 in**) - **1510 mm** (**59.4 in**) - **1610 mm** (**63.4 in**) - **1710 mm** (**67.3 in**) - **1810 mm** (**71.3 in**) - **1910 mm** (**75.2 in**)
Track settings WORKMASTER 45	**1410 mm** (**55.5 in**) - **1510 mm** (**59.4 in**) - **1610 mm** (**63.4 in**) - **1710 mm** (**67.3 in**) - **1810 mm** (**71.3 in**) - **1910 mm** (**75.2 in**)
Wheel camber	**2 °** corresponding to approx. **15 mm** (**0.6 in**) with **16 in** rims
Wheel toe-in	**0 - 5 mm** (**0 - 0.2 in**)
Swivel Pin Assembly	
Swivel pin diameter at the bushes	**37.96 mm** (**1.494 in**) - **38 mm** (**1.496 in**)
Press-fit bush inner diameter	**38.05 mm** (**1.498 in**) - **38.14 mm** (**1.50 in**)
Swivel pin to bush clearance	**0.05 mm** (**0.002 in**) - **0.179 mm** (**0.007 in**)
Axle Pivot Pin Assembly	
Pivot pin diameter	**37.96 mm** (**1.494 in**) - **38 mm** (**1.496 in**)
Press-fit bushing inner diameter	**38.05 mm** (**1.498 in**) - **38.14 mm** (**1.50 in**)
Pivot pin to bush clearance	**38.05 mm** (**1.498 in**) - **38.14 mm** (**1.50 in**)
Thrust Washer Thickness (Bronze) WORKMASTER 45 and WORKMASTER 55	**3.925 mm** (**0.155 in**) - **4.065 mm** (**0.160 in**)
Steel Washer Thickness WORKMASTER 45 and WORKMASTER 55	**3.925 mm** (**0.155 in**) - **4.00 mm** (**0.157 in**)

FRONT AXLE - Torque - 2WD

Description	Thread Size (mm)	Torque N.m (lb ft)
Capscrew, front axle carrier to engine **(C1)**	M18 x 1.5	**320 N·m** (**236 lb ft**)
Capscrew, axle pivot **(C2)**	M10 x 1.25	**60 N·m** (**44 lb ft**)
Capscrew, wheel to hub **(C3)**	M18 x 1.5	**366 N·m** (**270 lb ft**)
Nut, track/ drag link, ball joint **(C4)**	M14 x 1.5	**100 N·m** (**74 lb ft**)
Nut, right-hand and left-hand control lever **(C5)**	M14 x 1.5	**150 N·m** (**111 lb ft**)
Axle Extension securing bolts **(C6)**	M16 x 1.5	**118 N·m** (**87 lb ft**)



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FRONT AXLE - Sealing - 2WD

Operation Description	Sealant Specification
Front wheel hub sleeve	**LOCTITE® 638**
King pin thrust washer	**LOCTITE® 638**

FRONT AXLE - General specification - 4WD

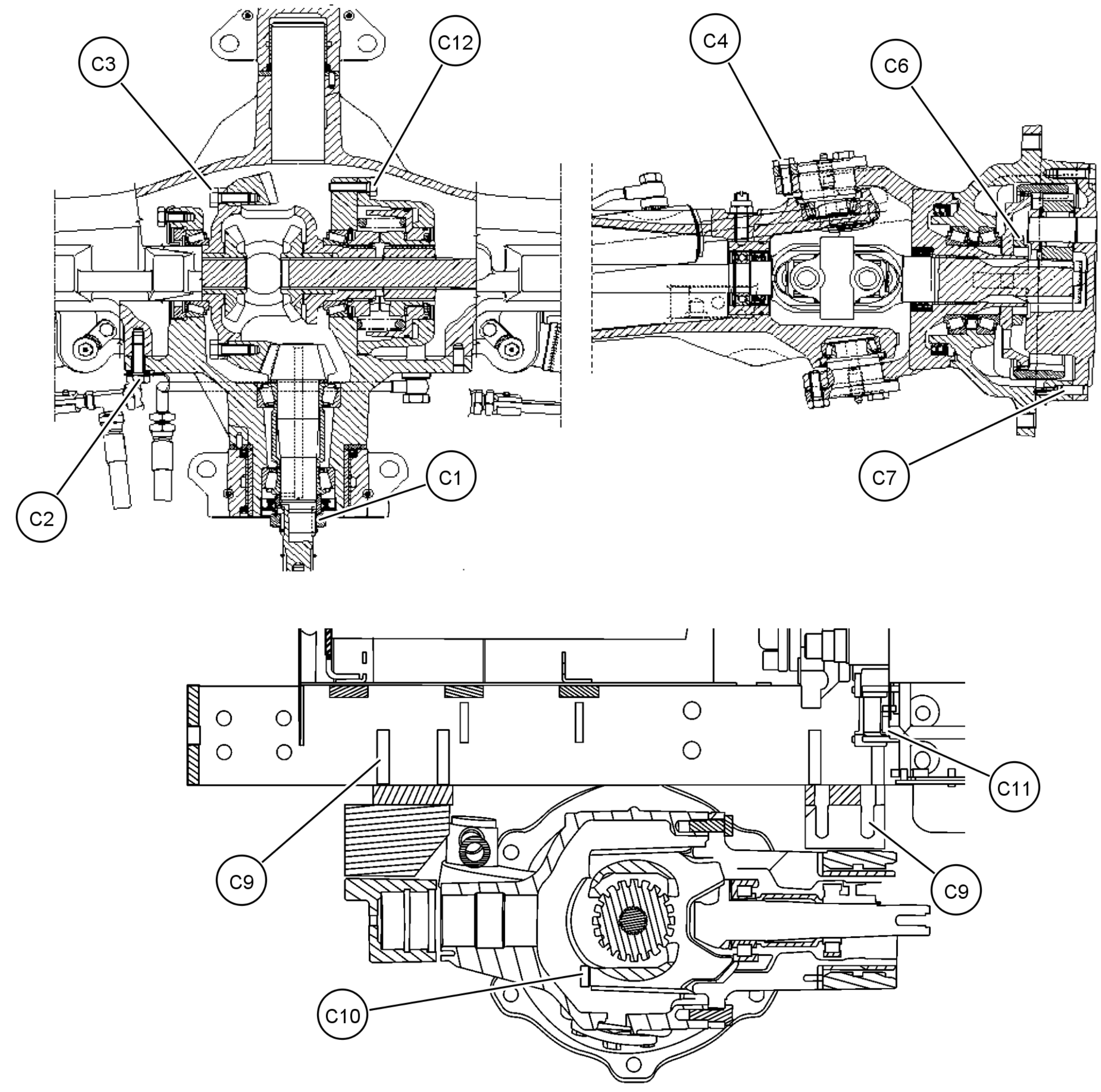
Bevel Gear Pair - Differential	
Pinion-ring gear ratio: Backlash between bevel gear pair: Ratio between front and rear wheel	9/38 = 1:4.2 **0.15 mm** (**0.006 in**) - **0.20 mm** (**0.008 in**) 1.374 (WORKMASTER 55) 1.411 (WORKMASTER 45)

Bevel Drive and Differential	
- Thickness of pinion bearing adjustment shim	**2.5 mm (0.0984 in) - 2.55 mm (0.1004 in) - 2.6 mm (0.1024 in) - 2.65 mm (0.1043 in) - 2.7 mm (0.1063 in) - 2.75 mm (0.1083 in) - 2.8 mm (0.1102 in) - 2.85 mm (0.1122 in) - 2.9 mm (0.1142 in) - 2.95 mm (0.1161 in) - 3.00 mm (0.1181 in) - 3.05 mm (0.1201 in) - 3.10 mm (0.1220 in) - 3.15 mm (0.1240 in) - 3.2 mm (0.1260 in) - 3.25 mm (0.1280 in) - 3.3 mm (0.1299 in) - 3.35 mm (0.1319 in) - 3.4 mm (0.1339 in) - 3.4 mm (0.1339 in) - 3.4 mm (0.1339 in) - 3.4 mm (0.1339 in) - 3.4 mm (0.1339 in) - 3.4 mm (0.1339 in) - 3.4 mm (0.1339 in) - 3.4 mm (0.1339 in) - 3.4 mm (0.1339 in) - 3.4 mm (0.1339 in) - 3.4 mm (0.1339 in) - 3.4 mm (0.1339 in) - 3.4 mm (0.1339 in) - 3.4 mm (0.1339 in) - 3.4 mm (0.1339 in) - 3.45 mm (0.1358 in) - 3.5 mm (0.1378 in) - 3.55 mm (0.1398 in) - 3.6 mm (0.1417 in) - 3.65 mm (0.1437 in) - 3.7 mm (0.1457 in)**
- Thickness of crown wheel position adjustment shim	**2.5 mm (0.0984 in) - 2.6 mm (0.1024 in) - 2.7 mm (0.1063 in) - 2.8 mm (0.1102 in) - 2.9 mm (0.1142 in) - 3.00 mm (0.1181 in) - 3.1 mm (0.1220 in) - 3.2 mm (0.1260 in) - 3.3 mm (0.1299 in) - 3.4 mm (0.1339 in) - 3.5 mm (0.1378 in) - 3.6 mm (0.1417 in) - 3.7 mm (0.1457 in)**
- Clearance between sides of planet and side pinion teeth - Thickness of planet pinion thrust washers - Thickness of side gear thrust washers	**0.15 mm (0.006 in)** **1.470 mm (0.058 in) - 1.530 mm (0.060 in)** **1.50 mm (0.059 in)** to **1.60 mm (0.063 in)**
- Diameter of cross pin for planet pinions - Side diameter cross pin bore diameter - Clearance between cross pin and bores	**21.939 mm (0.8637 in) - 21.960 mm (0.8646 in)** **22.040 mm (0.8677 in)** to **22.061 mm (0.8685 in)** **0.80 mm (0.0315 in) - 0.122 mm (0.0048 in)**
- Diameter of outer axle shafts and corresponding bushings - Inside diameter of installed bushings - Clearance between axle shafts and bushings - Type of differential lock (WORKMASTER 45, WORKMASTER 55)	**37.961 mm (1.4945 in) - 38.000 mm (1.4961 in)** **38.080 mm (1.4992 in)** to **38.119 mm (1.5007 in)** **0.080 mm (0.0031 in) - 0.158 mm (0.0062 in)** Limited Slip
Axle Shafts and Steering Knuckles	
- Diameter of outer axle shafts and corresponding bushings - Inside diameter of installed front bushings - Clearance between pin and bushings - Interference fit between bushings and respective bores - Thickness of steering knuckle bearing adjuster plates	**29.914 mm (0.0031 in) - 29.935 mm (1.1785 in)** **30.050 mm (1.1831 in) - 30.105 mm (1.1852 in)** **0.115 mm (0.0045 in) - 0.191 mm (0.0075 in)** **0.064 mm (0.0025 in) - 0.129 mm (0.0051 in)** **0.10 mm (0.0039 in) - 0.15 mm (0.0059 in) - 0.20 mm (0.0079 in) - 0.25 mm (0.0098 in) - 0.30 mm (0.0118 in)**
Planetary Final Drives - Reduction ratio - Driven gear thrust washer thickness	**15 mm (0.5906 in):(19 mm (0.7480 in)+ 54 mm (2.1260 in))** = 1:4.87 **0.77 mm (0.0303 in) - 0.83 mm (0.0327 in)**
Axle Pivot	
Pivoting angle/oscillation (on either side) Center pivot and support end float Max. wear clearance	**11 °** **0.3 mm (0.0118 in) - 1.1 mm (0.0433 in)** **2 mm (0.0787 in)**
Center pivot diameter Center pivot front bushing fitted Center pivot working clearance in bushing	**52.652 mm (2.0729 in) - 52.671 mm (2.0737 in)** **52.720 mm (2.0756 in) - 52.790 mm (2.0783 in)** **0.049 mm (0.0019 in) - 0.138 mm (2.0783 in)**
Rear bevel pinion carrier spigot Rear bushing fitted Spigot fitted clearance in bushing	**99.040 mm (3.8992 in) - 99.72 mm (3.9260 in)** **99.146 mm (3.9034 in) - 99.221 mm (3.9063 in)** **0.074 mm (0.0029 in) - 0.181 mm (0.0071 in)**

Axle front and rear thrust washer thickness	**4.95 mm** (**0.1949 in**) - **5.00 mm** (**0.1969 in**)
Turning radius: - Live axle in Brakes off (WORKMASTER 45) - Live axle in Brakes off (WORKMASTER 55) - Live axle in Brakes on (WORKMASTER 45) - Live axle in Brakes on (WORKMASTER 55)	 **5100 mm** (**201 in**) **5100 mm** (**201 in**) **4225 mm** (**166 in**) **4225 mm** (**166 in**)
Turnaround diameter: - Live axle in Brakes off (WORKMASTER 45) - Live axle in Brakes off (WORKMASTER 55) - Live axle in Brakes on (WORKMASTER 45) - Live axle in Brakes on (WORKMASTER 55)	 **8725 mm** (**344 in**) **8680 mm** (**342 in**) **6975 mm** (**275 in**) **6930 mm** (**273 in**)
Maximum axle steering angle (WORKMASTER 45, WORKMASTER 55)	**55 °**
Camber angle (WORKMASTER 45, WORKMASTER 55)	**2 °**
Caster angle (WORKMASTER 45, WORKMASTER 55)	**2 °**
Tire Sizes	
Front (WORKMASTER 45) FWD	9.5 x 24
Rear (WORKMASTER 45) FWD	16.9 x 28
Front (WORKMASTER 55) FWD	11.2 x 24
Rear (WORKMASTER 55) FWD	16.9 x 30

FRONT AXLE - Torque - 4WD

Description	Thread Size (mm)	Torque N.m (lb ft)
Front axle Lock ring, bevel pinion **(C1)**	M 35 x 1.5	**294 N·m** (**217 lb ft**)
Capscrew, differential case to axle casing **(C2)**	M 12 x 1.25	**113 N·m** (**83 lb ft**)
Capscrew, ring gear to differential case **(C3)**	M 12 x 1.25	**127 N·m** (**94 lb ft**)
Capscrew, king pin **(C4)**	M 10 x 1.25	**64 N·m** (**47 lb ft**)
Steering knuckle capscrew **(C5)**	M 10 x 1.25	**64 N·m** (**47 lb ft**)
Wheel hub bearings lock nut **(C6)**	M 45 x 1.5	**392 N·m** (**289 lb ft**)
Capscrew, planetary final drive housing **(C7)**	M 10 x 1.25	**64 N·m** (**47 lb ft**)
Capscrew, wheel disc to hub **(C8)**	M 16 x 1.5	**193 N·m** (**142 lb ft**)
Nut for rim to disc securing bolt	M 16 x 1.5	**193 N·m** (**142 lb ft**)
Front axle front and rear pivot support bolt **(C9)**	M 18 x 1.5	**280 N·m** (**207 lb ft**)
Differential cage support cap bolt **(C10)**	M 12 x 1.25	**113 N·m** (**83 lb ft**)
Front axle support to engine retaining bolt **(C11)**	M 18 x 1.5	**314 N·m** (**232 lb ft**)



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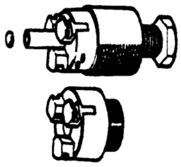
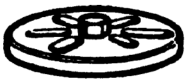
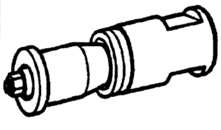
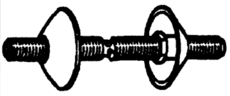
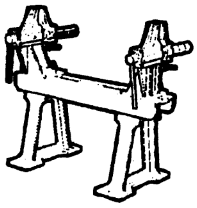
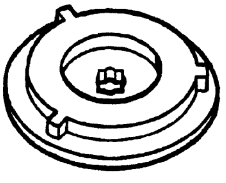
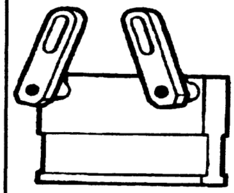
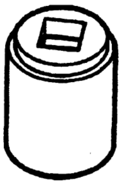
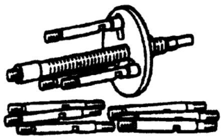
FRONT AXLE - Special tools - 4WD

SPECIAL TOOLS

Tool #	Cross Over Tool #	Tool Figure	Description	Tractor Series also Used On
380000234*	292161		Front axle pivot bearing outer ring removal tool	TL and TM
380000235*	292220		Measurement of rolling torque of front axle bearing	TL and TM
380000248*	NH01326 or 293391		Pinion Bearing Preload Adjustment tool	40 / TS / 60 / TM / TN / TL
380000249*	NH01296 or 293400		Universal gauge for positioning of front bevel drive pinion	40 / TS / 60 / TM
380000251*	293460 or 99322215		Front Axle overhaul stand	TM
380000252*	NH01320 or 293544		Wrench for differential case bearing threaded adjustment nut	40 / TS / 60 / TM / TN / TL
380000255	293743		Overhaul support for front axle differential case	TL and TM
380000257*	NH01321 or 293782		Front bevel drive pinion lock key wrench	40 / TS / 60 / TM / TN / TL
380000265*	NH01286 or 293857		Front axle king pin removal tool	40 / TS / 60 / TM / TN / TL

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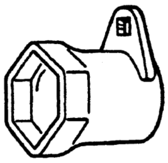
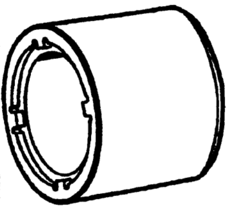
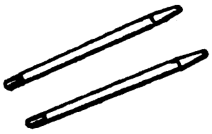
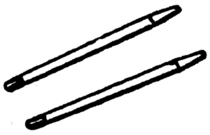
Tool #	Cross Over Tool #	Tool Figure	Description	Tractor Series also Used On
380000268*	NH01289 or 293878		Pinion Shaft Spanner	40 / TS / 60 / TM / TL
380000295*	NH01319 or 295030		Wrench for front axle wheel hub bearing retaining nut	40 / TS / 60 / TM / TN / TL
380002813*	NA		Dowel studs (set of 2) (M10 x 1.25 x 100) (Fine thread) For front axle cover removal	TN
380002814*	NA		Dowel studs (set of 2) (M12 x 1.25 x 100) (Fine thread) For front axle differential cover removal	TN

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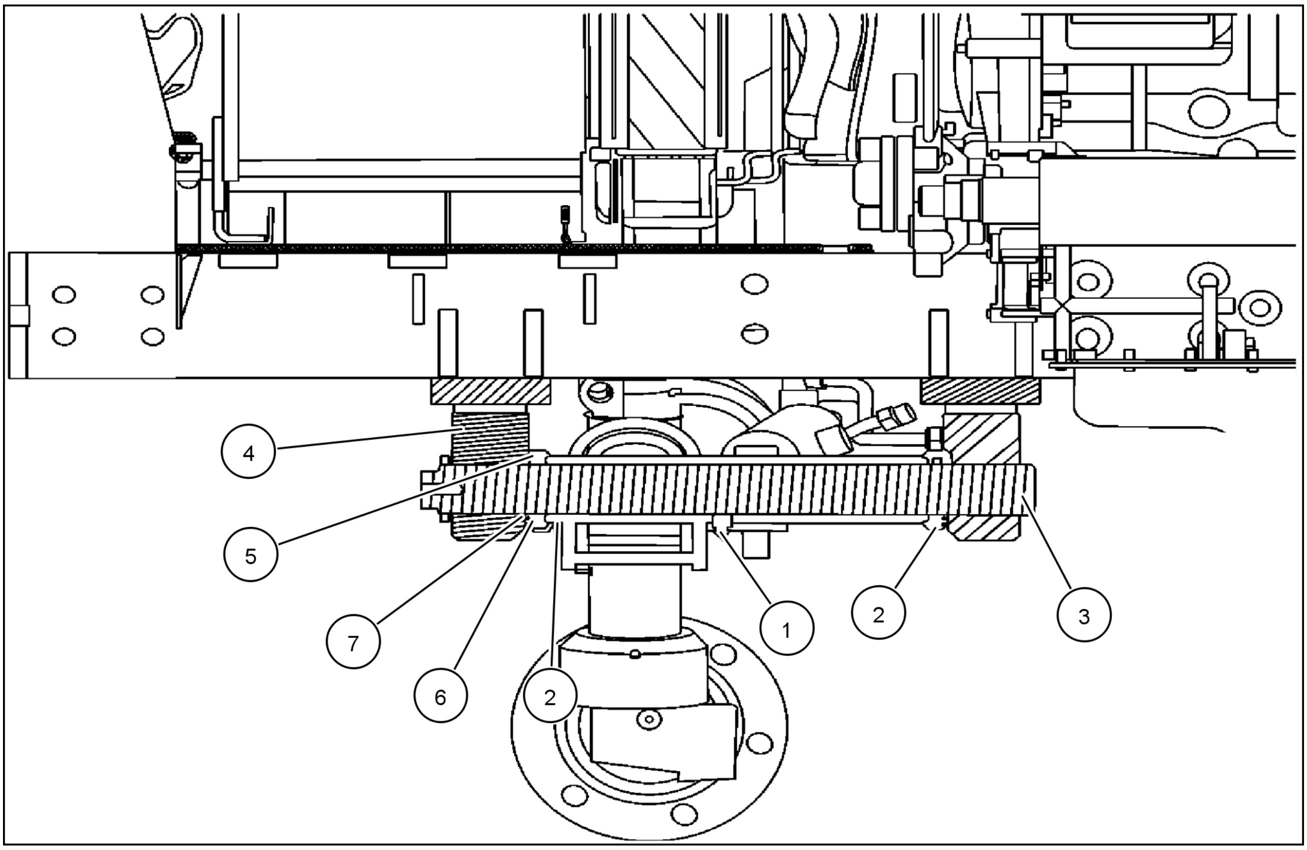
FRONT AXLE - Sectional view - 2WD

FRONT AXLE SUPPORT



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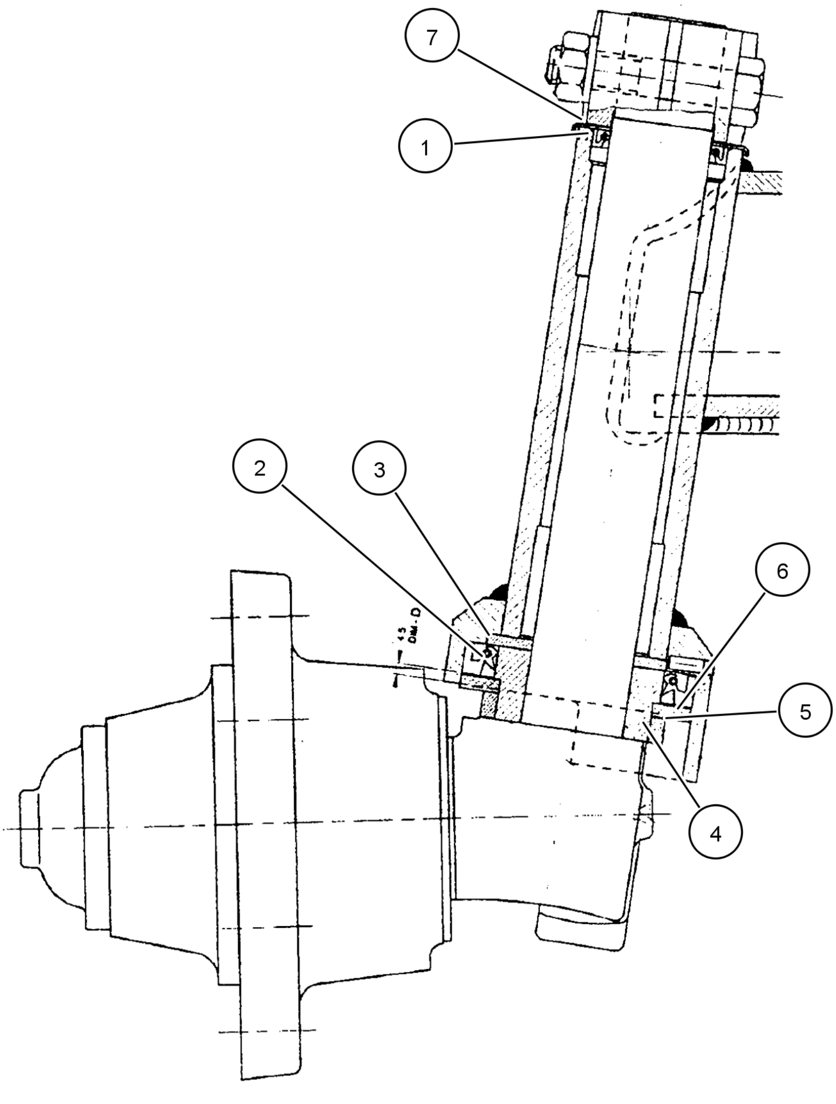
1.	Grease fitting	5.	Seal
2.	Axle pivot bushings	6.	Thrust washer
3.	Axle pivot pin	7.	Shim washer
4.	Front axle carrier		

FRONT AXLE - Sectional view - 2WD

STUB ASSEMBLY



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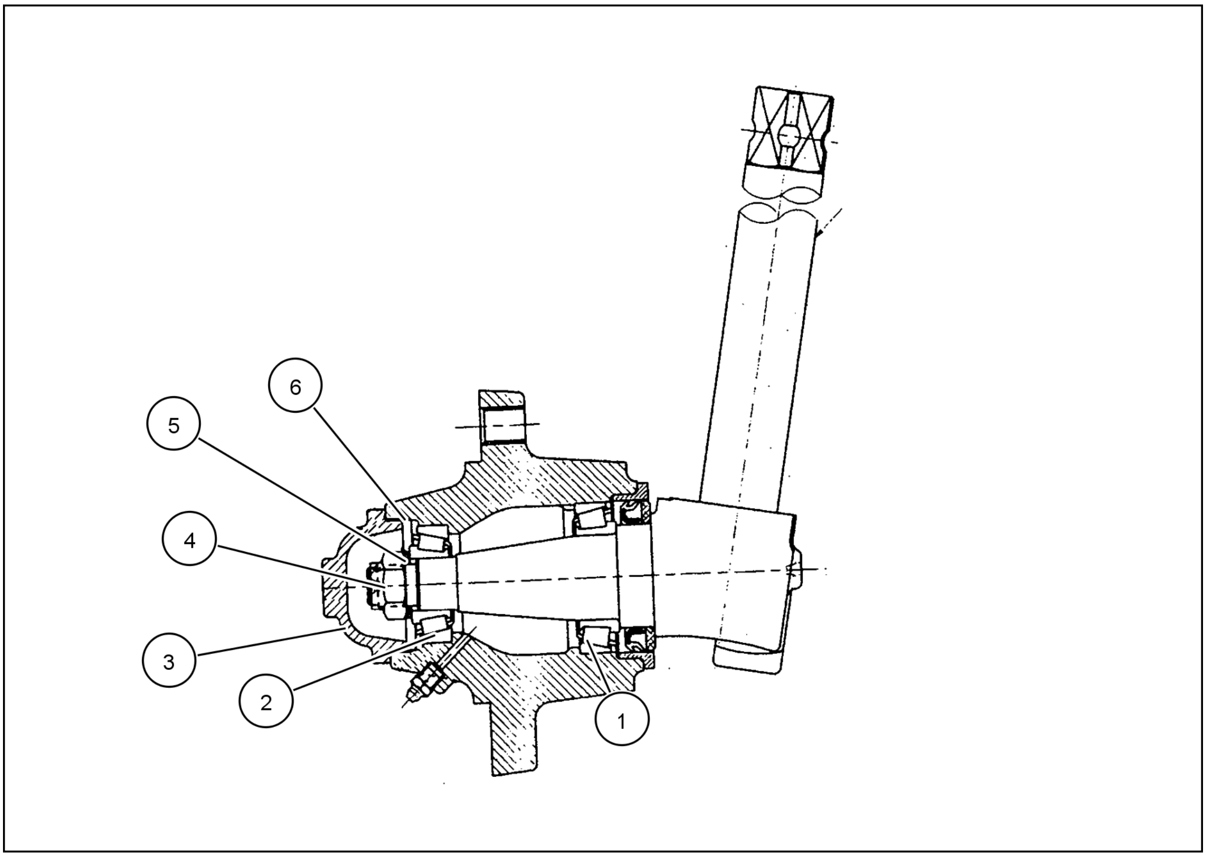
1. Seal Assembly
2. Seal Assembly
3. Thrust washer
4. Thrust washer
5. Dust cover seal collar
6. Dust cover seal lower
7. Dust cover seal upper



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1. Bearing inner
2. Bearing outer
3. Hub cap
4. Hexagonal nut
5. Washer
6. O-ring

FRONT AXLE - Static description - 2WD

The adjustable front axle is composed of a reversed ’U’ type center beam with telescopic sections at each end.

A number of holes at **50 mm** (**2 in**) intervals are provided in the telescopic sections for track width adjustment purpose. Adjustment of the front wheel track width is affected by extending or retracting both ends of the axle equally.

The center beam is attached to the front axle carrier by means of a single pivot which allows oscillation on both sides.

The front axle is controlled by power/manual steering through swivel pin control lever. The swivel pins are connected by telescopic track control rod, which contain adjustment for toe-in.

FRONT AXLE - Dynamic description - 4WD

The tractor has a centrally pivoting front axle with the pivot and the drive shaft coaxial with the longitudinal axis of the tractor. The drive shaft has no universal joints.

The differential has two planet pinions; drive is transmitted to lateral epicyclic final drive units (installed on the wheel hubs) through universal joints which require no maintenance.

FRONT TO REAR AXLE RATIO

WORKMASTER 45, WORKMASTER 55

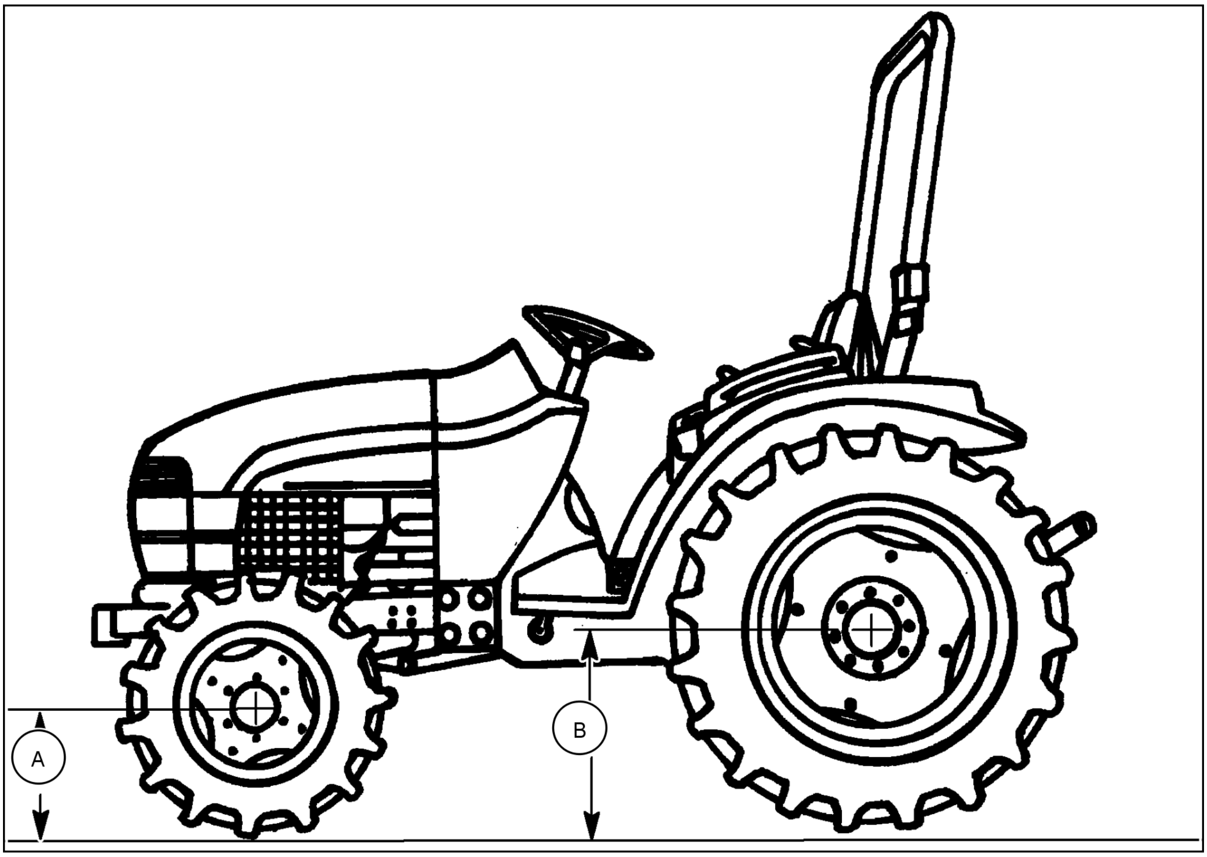
NOTE: *On tractors equipped with FWD (Front Wheel Drive) the front to rear axle ratio is critical and must be maintained for safe and efficient use of the tractor. This ratio applies to all available tire options. Following is a list of problems that may occur if the front to rear axle ratio is not maintained:*

WORKMASTER 45	1.411:1, Acceptable range 1.38 - 1.44:1
WORKMASTER 55	1.374:1, Acceptable range 1.35 - 1.40:1

- Engine will lug down or stall when operating on hard surfaces.
- The front wheel drive lever will not remain in the engaged position, or is difficult to disengage.
- Failure of the drive line gears.
- Failure of the front axle, ring and pinion gears.
- Premature tire wear.

To calculate the front to rear axle ratio, use method 1 or method 2.

Method 1:



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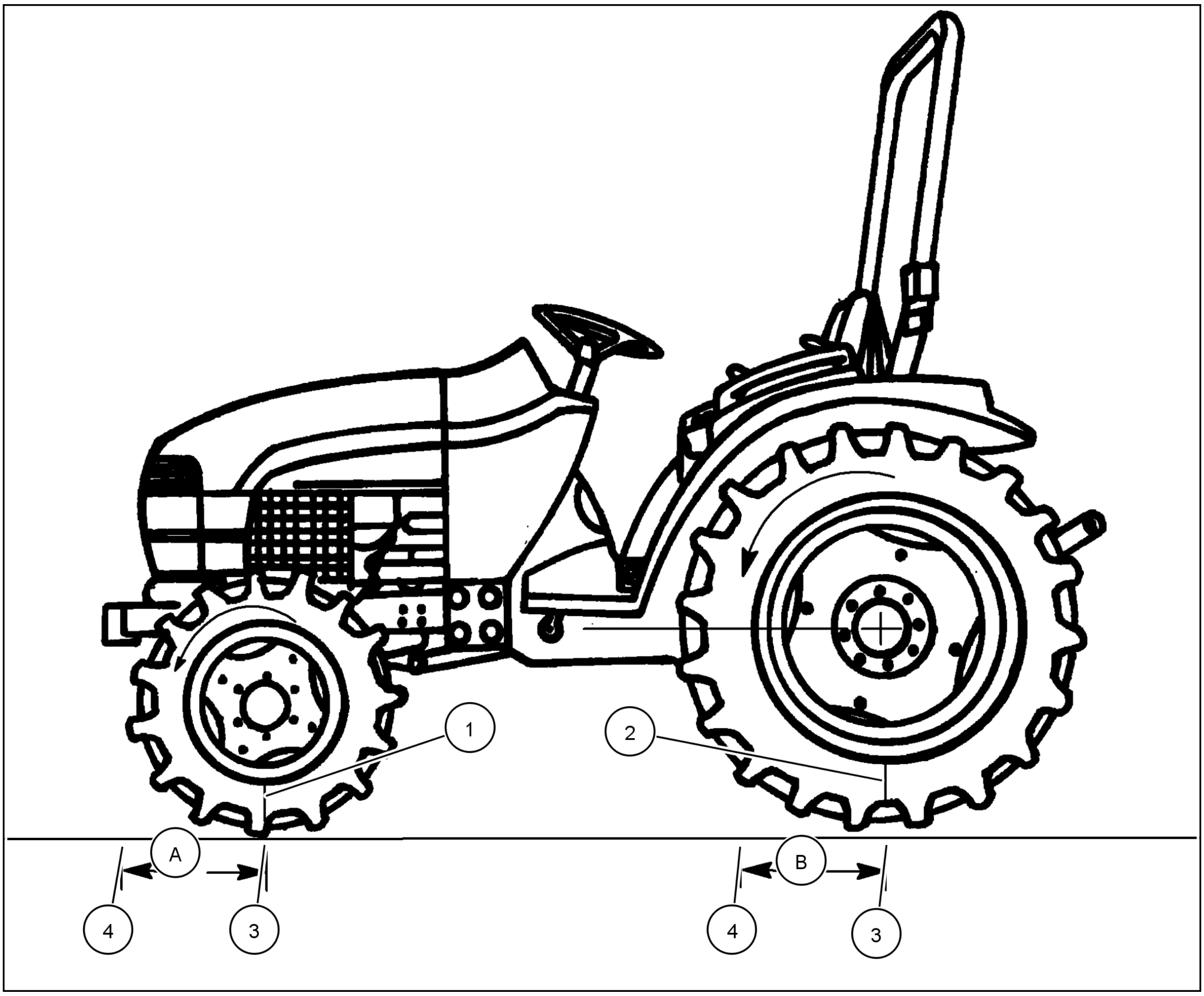
1. Obtain a measurement from the center of the front axle to the ground (Distance A), and center of the rear axle to the ground (Distance B).
2. Divide Distance B by Distance A to calculate the front to rear axle ratio. (“B” ÷ “A” = Front to rear ratio.)
3. To change the front to rear ratio, increase or decrease the tire inflation pressure.

NOTE: *Do not exceed the tire inflation pressures recommended in the Operators Manual. Consult the Operators Manual for the available tire sizes for a specific tractor.*

Method 2: Rolling Test



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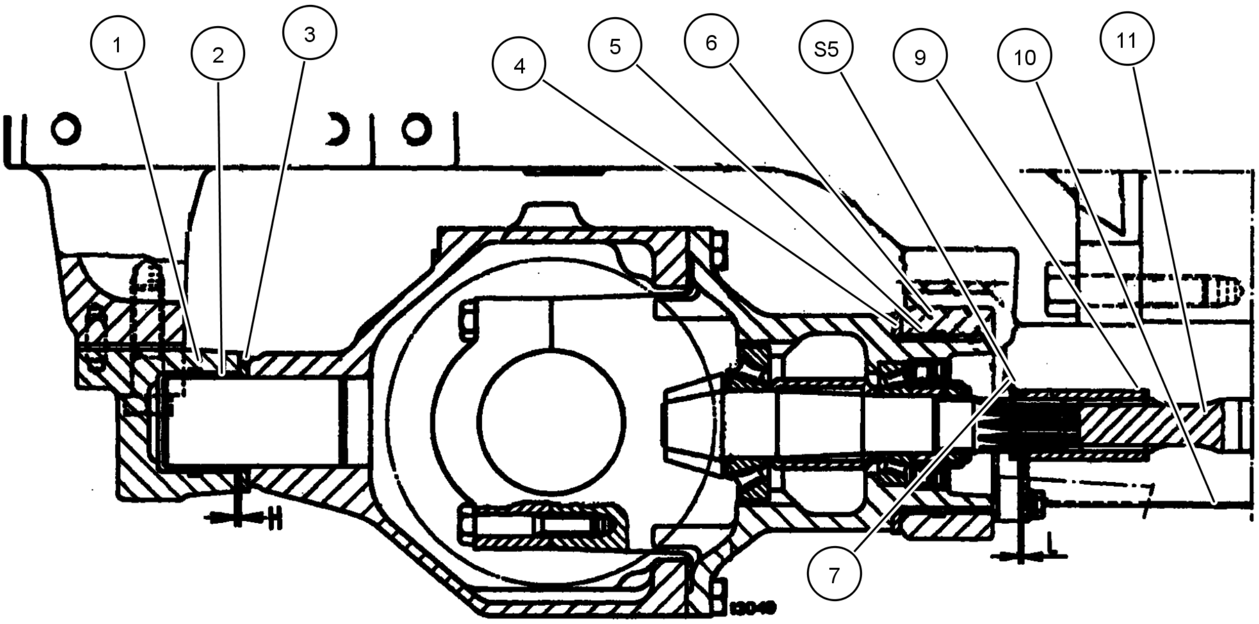
1. Make a mark on the front tire, **(1)**, and the rear tire, **(2)**.
2. Make a corresponding mark, **(3)**, on the ground at each tire.
3. Slowly roll the tractor forward until the marks on the tires, **(1)** and **(2)**, make one full revolution.
4. Make a second mark, **(4)**, on the ground as in step **(2)**.
5. Measure the distance between the marks on the ground for each tire.
6. Divide the distance B by the distance A to calculate the front to rear ratio.
7. To change the front to rear ratio, increase or decrease the tire inflation pressure, or check the rear counterbalance weights.

NOTE: *Do not exceed the tire inflation pressures recommended in the Operators Manual. Consult the Operators Manual for the available tire sizes and inflation pressures for a specific tractor.*

Axle - Sectional view - 4WD



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Cross-sectional view of front axle pivot

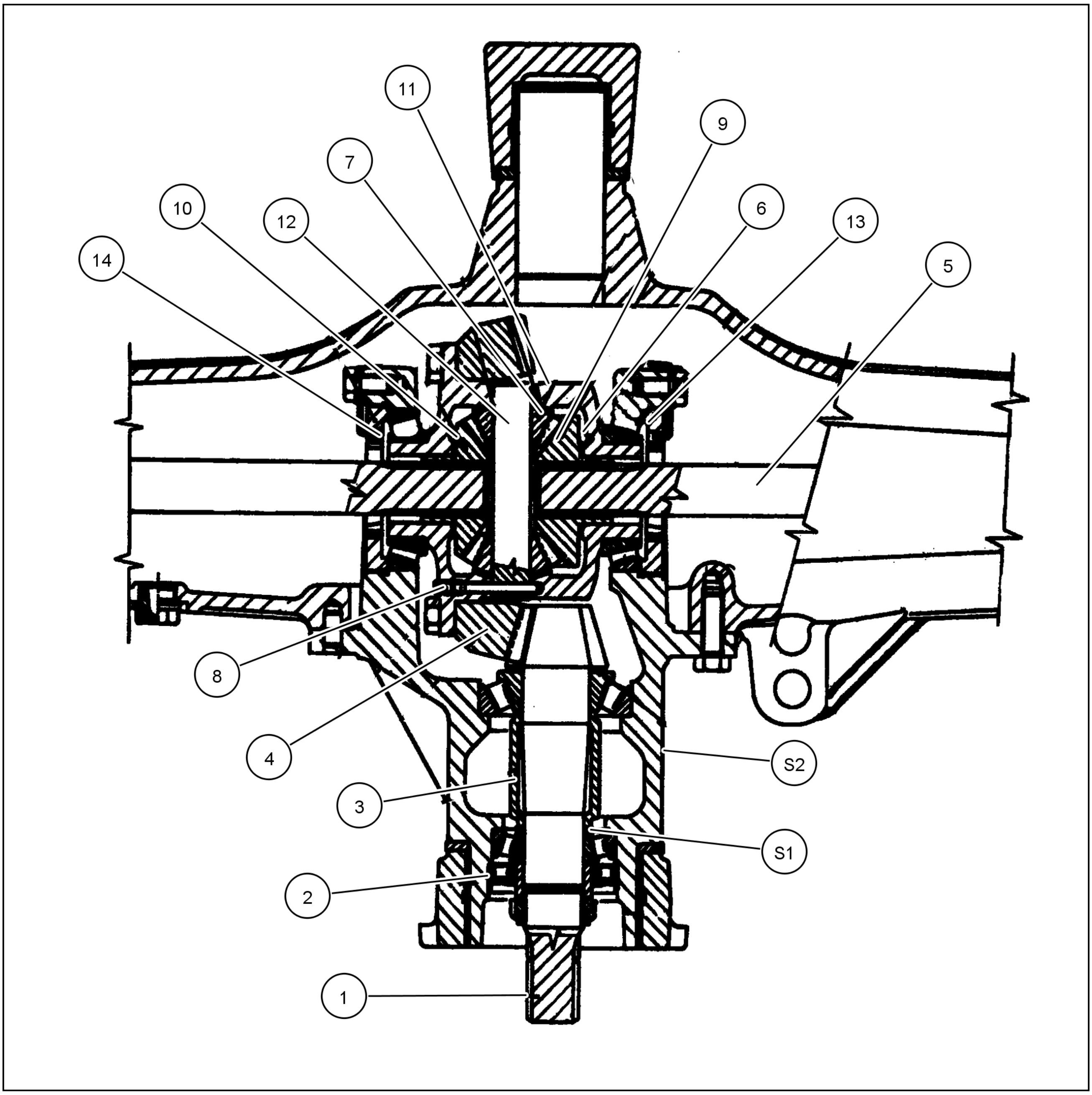
H = **1 mm** (**0.039 in**)

1. Front axle pivot support
2. Front bushing
3. Front thrust washer
4. Rear thrust washer
5. Rear bushing
6. Rear axle pivot support
7. Retaining rings

L = **1 - 1.5 mm** (**0.039 - 0.059 in**)
S5 = Sleeve position shim

8. Front splined sleeve
9. Retaining rings
10. Drive shaft guard
11. Drive shaft

Differential - Sectional view - 4WD



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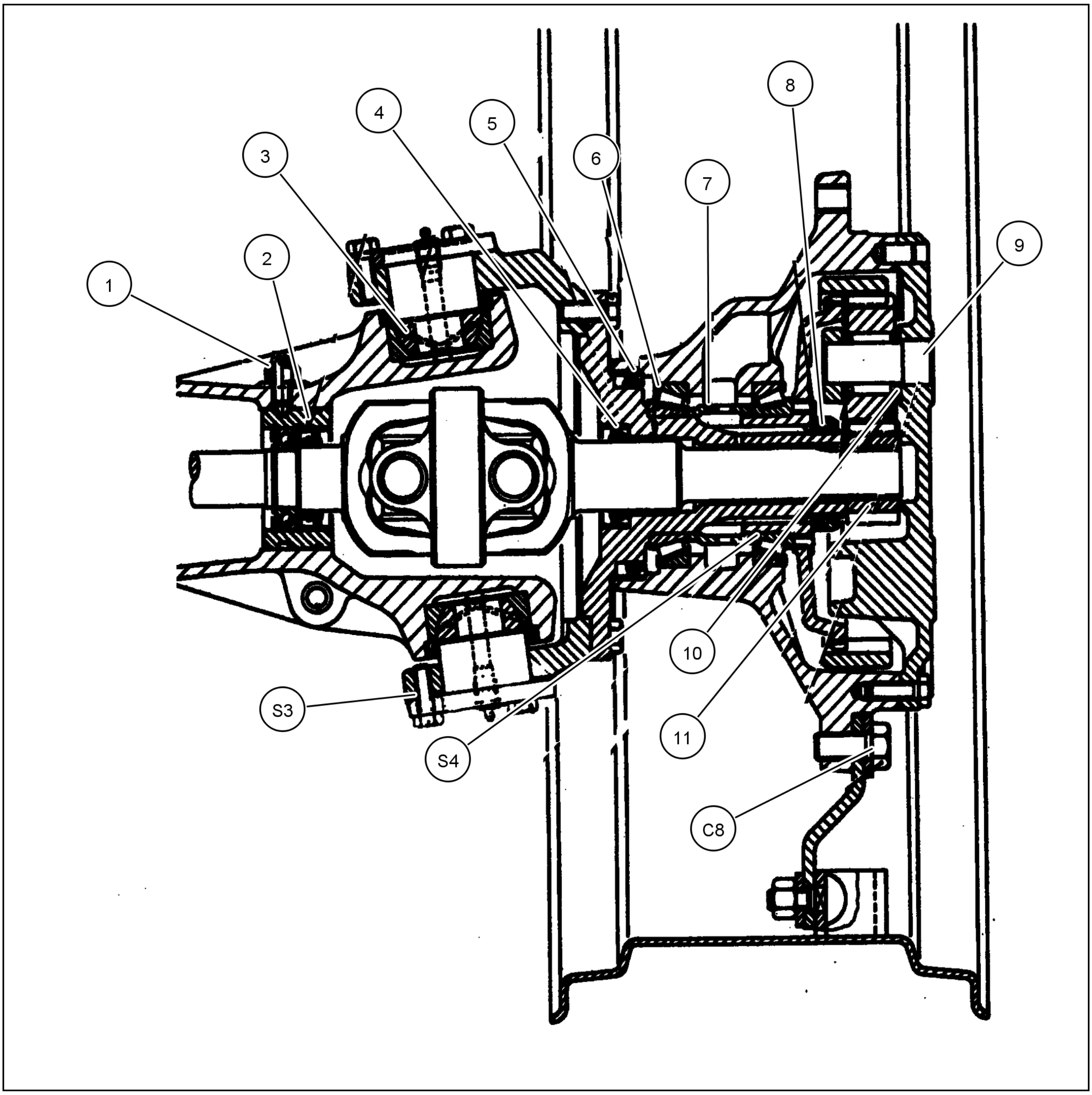
Cross-sectional view of front axle differential

S1 = Bevel pinion bearing shim
1. Bevel pinion
2. Seal
3. Bevel pinion bearing spacer
4. Ring gear
5. Axle shaft with universal joint
6. Side gear washers
7. Differential pinion washers

S2 = Bevel pinion position shim
8. Differential pinion journal capscrew
9. Side gear
10. Side gear
11. Differential pinion
12. Differential pinion journal
13. Right side differential bearing lock ring
14. Left side differential bearing lock ring

Steering knuckle and King pin - Sectional view - 4WD



20097650 1

Cross-sectional view of front axle steering knuckle and hub

S3 = King pin bearing shim

1. Bearing carrier capscrew
2. Seal
3. King pin bearing
4. Seal
5. Seal
6. Axle shaft bushing
7. Spacer

S4 = Wheel hub bearing shims
C8 = Wheel hub capscrew.

8. Thrust washers
9. Planet wheel journals
10. Planet wheel shims
11. Sun gear

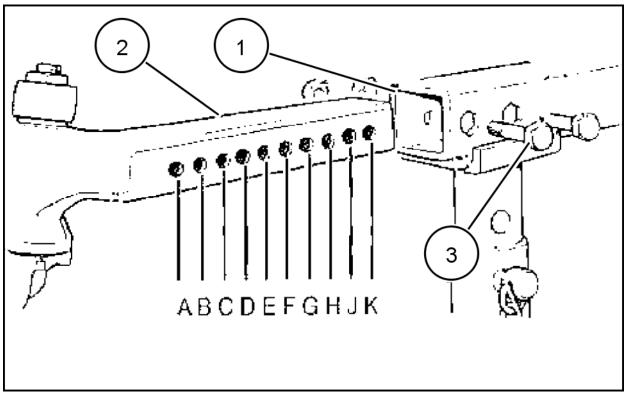
FRONT AXLE - Adjust Track

Front Wheel Track Adjustment

The front axle consists of a hollow center beam, **(1)**, with a telescopic section, **(2)**, at each end. Seven holes at **50 mm** (**1.97 in**) intervals are provided in the telescopic sections for adjustment purposes. Adjustment of the front wheel track width is effected by extending both ends of the axle equally.

To extend the axle, apply the hand brake and place blocks at the front and rear of the rear wheels. Jack up the front axle and place on axle stands. Remove the securing bolts, **(3)**, securing the left-hand telescopic section to the center beam.

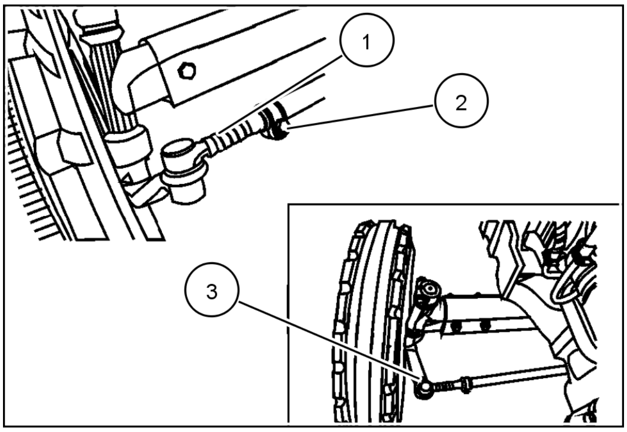
Repeat the same for the right-hand side of the axle.



20097896 1

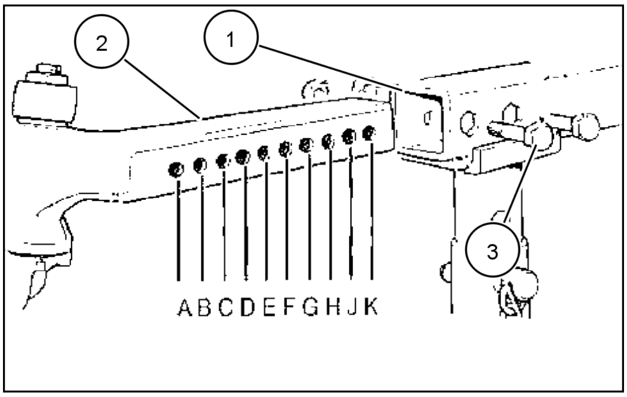
The tie rod is adjustable and consists of a central, hollow tube with a solid extendible section at each end. The left-hand end of the tie rod has a number of notches, **(1)**, at **50 mm** (**1.97 in**) intervals. A locating bolt, **(2)**, passes through a clamp and one of the notches in the solid section and locks the tie rod assembly at the desired length. Additionally, the right-hand end of the tie rod is threaded, **(3)**, to provide fine adjustment of toe-in.

Remove the locating bolt, **(2)**, from the left-hand end of the tie rod. This will permit the tie rod to extend or retract freely.



20096256 2

Reset both axle telescopic sections. Passing the securing bolts through the center beam and telescopic sections, as indicated in figure **3**, and table below:



20097896 3

WORKMASTER 45 2WD

Track Setting 6.00-16 SL mm (in)	Securing Bolt Location
2WD Dished In	
1250 mm (**49 in**)	A and C
1350 mm (**53 in**)	B and D
1450 mm (**57 in**)	C and E
1550 mm (**61 in**)	D and F
1650 mm (**65 in**)	E and G
NA	F and H

2WD Dished Out	
1362 mm (**54 in**)	A and C
1462 mm (**58 in**)	B and D
1562 mm (**61 in**)	C and E
1662 mm (**65 in**)	D and F
1762 mm (**69 in**)	E and G
NA	F and H

WORKMASTER 55 2WD

With Reversing Wheel Rim 6.00-16 SL mm (in)	**With Reversing Wheel Rim 7.50-16 SL mm (in)**	**Securing Bolt Location**
2WD Dished In		
1360 mm (**54 in**)	**1385 mm** (**55 in**)	A and C
1460 mm (**57 in**)	**1485 mm** (**58 in**)	B and D
1560 mm (**61 in**)	**1585 mm** (**62 in**)	C and E
1660 mm (**65 in**)	**1685 mm** (**66 in**)	D and F
1760 mm (**69 in**)	**1785 mm** (**70 in**)	E and G
1860 mm (**73 in**)	**1885 mm** (**74 in**)	F and H
2WD Dished Out		
1430 mm (**56 in**)	**1420 mm** (**56 in**)	A and C
1530 mm (**60 in**)	**1520 mm** (**60 in**)	B and D
1630 mm (**64 in**)	**1620 mm** (**64 in**)	C and E
1730 mm (**65 in**)	**1720 mm** (**66 in**)	D and F
1830 mm (**72 in**)	**1820 mm** (**72 in**)	E and G
1930 mm (**76 in**)	**1920 mm** (**73 in**)	F and H

NOTE: *The track settings shown are approximate. The front wheel discs are off-set, relative to the center line of the rim. The track settings in the table are with the dished side of the wheel nearest the axle hub. If the front wheels are reversed on the hubs the track settings shown in the table will be increased by approximately* ***25 mm*** *(****0.98 in****).*

Tighten the nuts on the axle extension securing bolts to **118 N·m** (**87.0 lb ft**).

With both front wheels parallel, install the locating bolt in the nearest aligning notch in the tie rod. Tighten the nut on the locating bolt to **24.5 N·m** (**18 lb ft**).

Re-check all torque settings after 50 hours of operation.

Front disc to hub bolts **123 N·m** (**91 lb ft**).

FRONT AXLE - Remove - 2WD

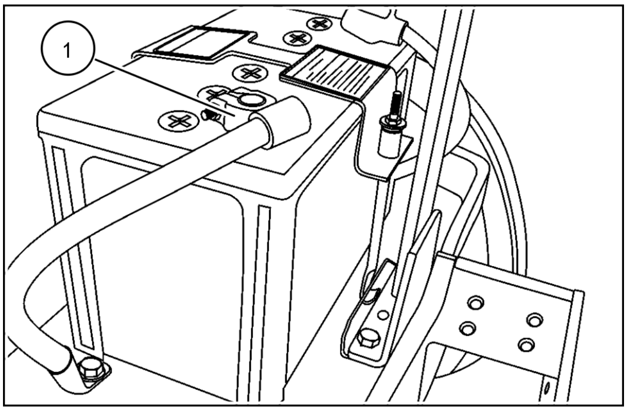
⚠ **DANGER** ⚠

Lift and handle all heavy components using lifting equipment of appropriate lifting capacity. Make sure that units or parts are supported by suitable slings or hooks. Make sure that no-one is in the vicinity of the load to be lifted. Failure to comply could result in serious injury or death.

B012

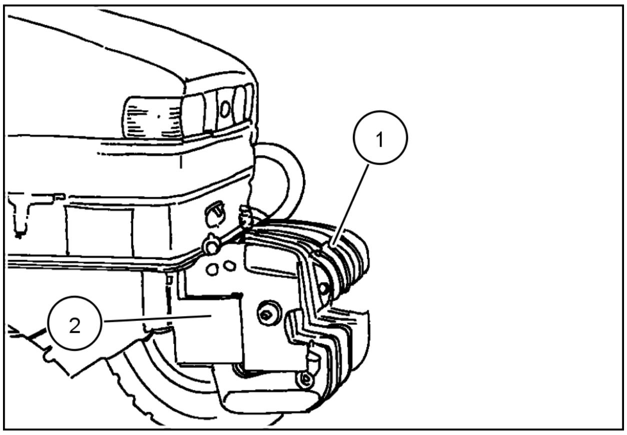
Remove the front axle assembly from the tractor as follows:

1. Open and raise front hood.
2. Disconnect the negative cable, **(1)**, from the negative battery terminal.



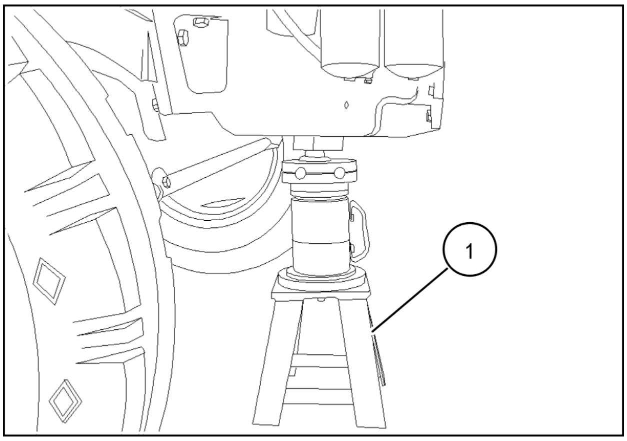
20099930 1

3. Safely block rear wheels.
4. Remove front weights, **(1)**, and weight support, **(2)**, when fitted.



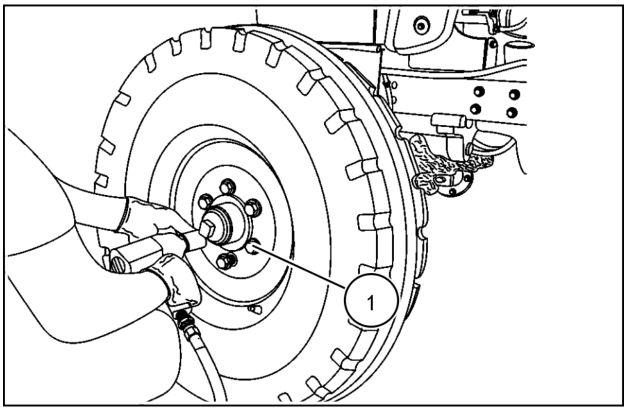
20097800 2

5. Use a floor jack to raise the front of the tractor and place a stationary stand, **(1)**, under the front frame.



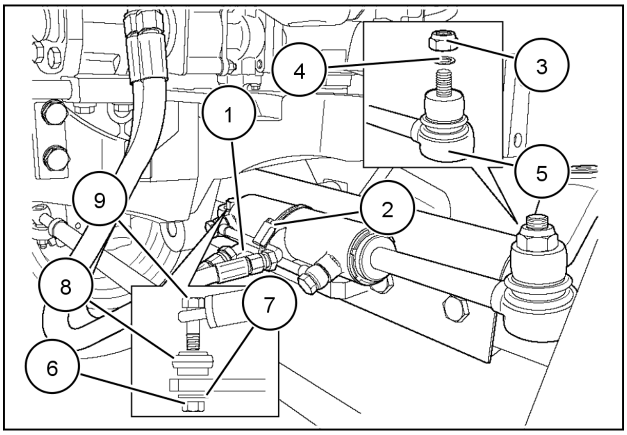
20097801 3

6. Loosen retaining bolts, **(1)**, and remove the front wheels.



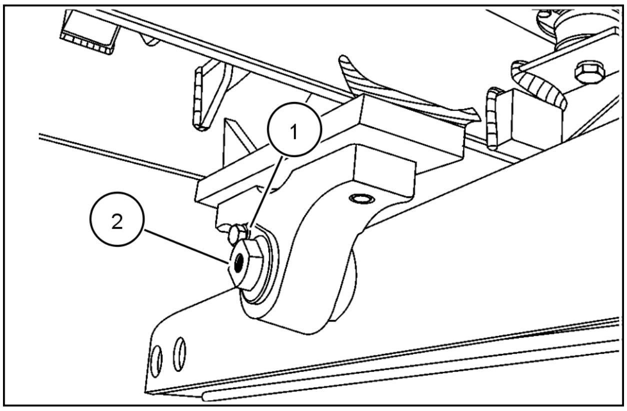
20099931 4

7. Disconnect the flexible hoses, **(1)**, from the steering cylinder. Remove the hose clamp, **(2)**, and spacer.
8. Remove the nut, **(3)**, and belleville washer, **(4)**, securing the cylinder rod ball joint, **(5)**, to the steering arm and separate the joint.
9. Remove the nut, **(6)**, and belleville washer, **(7)**, securing the steering cylinder on the front axle beam.
10. Remove the steering cylinder from the tractor and remove bushing, **(8)**, and pin, **(9)**.



200900120 5

11. Remove the axle pivot pin locking bolt, **(1)**.
12. Using a slide puller with appropriate adapter, withdraw the pivot pin, **(2)**, and recover thrust washers and shims provided between axle carrier and center beam.
13. Remove front axle from tractor using a suitable hoist.



20099977 6

Next operation:
FRONT AXLE - Install - 2WD (D.10.A)

FRONT AXLE - Install - 2WD

Prior operation:
FRONT AXLE - Remove - 2WD (D.10.A)

Reinstall the front axle assembly to carrier observing the following:

⚠ **WARNING** ⚠

Always use suitable tools to align holes. DO NOT USE HAND OR FINGERS. Failure to comply could result in death or serious injury.

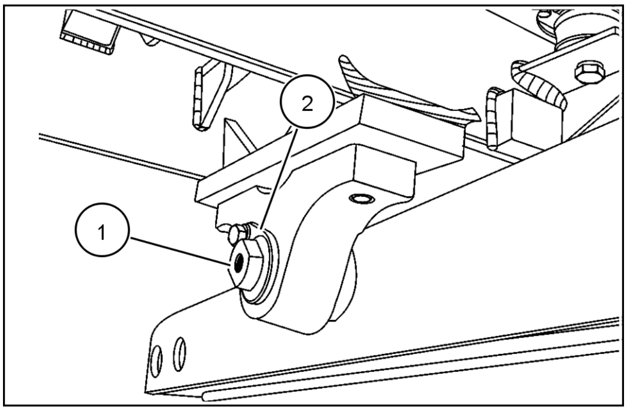
B020A

⚠ **DANGER** ⚠

Lift and handle all heavy components using lifting equipment of appropriate lifting capacity. Make sure that units or parts are supported by suitable slings or hooks. Make sure that no-one is in the vicinity of the load to be lifted. Failure to comply could result in serious injury or death.

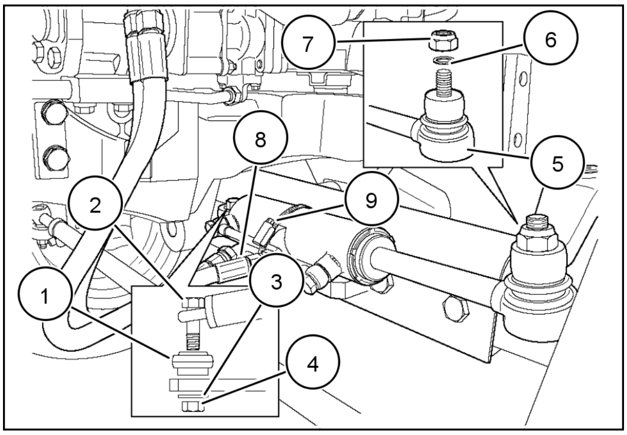
B012

1. Place the front axle under the tractor. Use a suitable lifting device to raise the front axle into position.
2. Install the axle pivot pin, **(1)**, thrust washers, shims and secure with the axle pivot pin bolt, **(2)** and lock washer. Torque the M10 x 1.25 x 20 mm to **60 N·m** (**44 lb ft**)
3. Check the pivot pin play. It should not exceed **0.25 mm** (**0.0098 in**). If play is more, add shims between axle carrier and center beam.



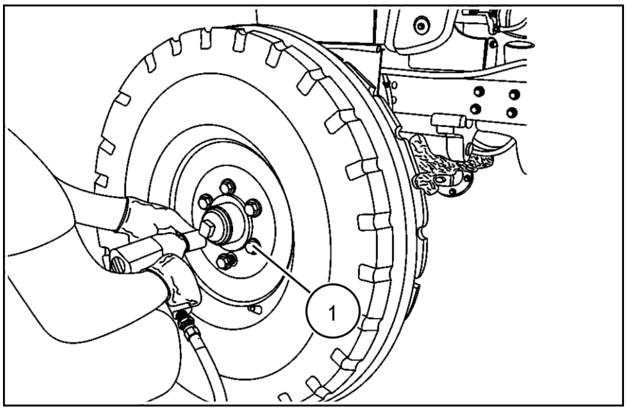
20099977 1

4. Place the steering cylinder onto the front axle beam.
5. Install the bushing, **(1)**, pin, **(2)**, and belleville washer, **(3)**. Secure using the nut, **(4)**.
6. Insert the cylinder rod ball joint, **(5)**, into the steering arm.
7. Secure the cylinder rod ball joint with the belleville washer, **(6)**, and nut, **(7)**.
8. Reconnect the flexible hoses, **(8)**, to the proper tubes on the steering cylinder.
9. Reinstall the spacer and hose clamp, **(9)**.
10. Check for correct toe-in setting. Refer to **FRONT AXLE - Test (D.10.A)** for details.
11. Tighten all fasteners to correct torques as detailed in Tightening Torques. **FRONT AXLE - Torque (D.10.A)**.



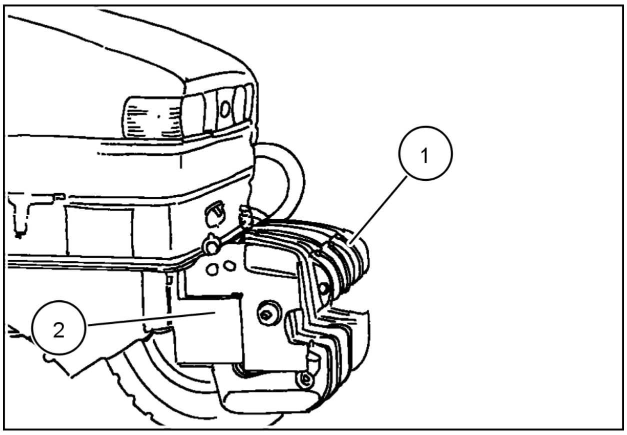
200900120 2

12. Reinstall front wheels, **(1)**. Torque the M18 x 1.50 retaining cap screws to **333 N·m** (**246 lb ft**) ± **19 N·m** (**14 lb ft**).
13. Remove jack and/or stands from underneath the tractor.



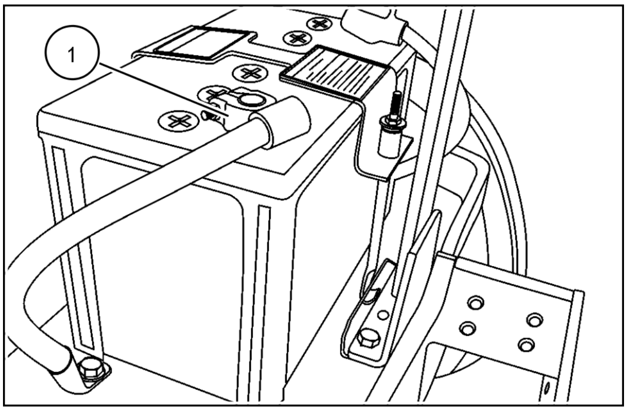
20099931 3

14. Reinstall front weight support, **(1)**.
15. Install weights, **(2)**, from removal.



20097800 4

16. Reconnect the negative battery cable, **(1)** to the negative battery terminal.

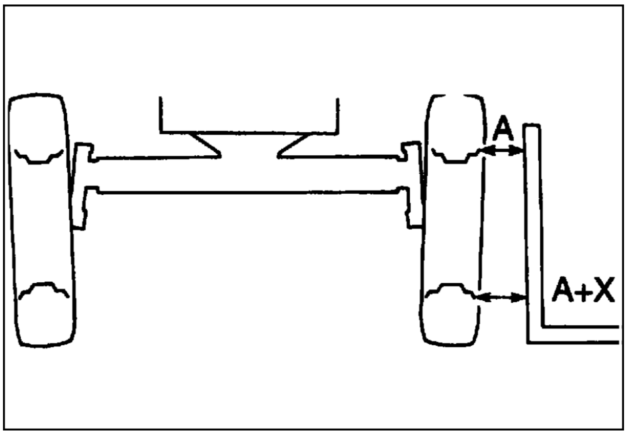


20099930 5

FRONT AXLE - Test Front wheel setting tests

Wheel Camber Test

Check the front wheel camber considering that when the tractor moves along a straight line, wheels should be tilted by 2 degrees relative to the ground, corresponding to a difference (X) of approximately **15 mm** (**0.591 in**) between the rim edges.



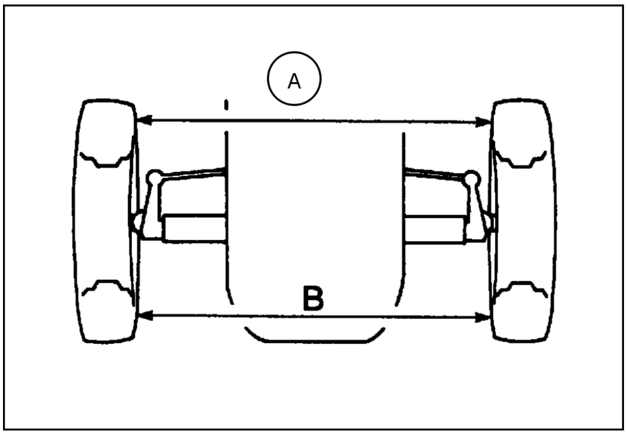
20097804 1

Front Wheel Toe-in Test

When the tractor moves along a straight line, wheels should be parallel to the tractor center line or slightly toe-in until a max. of **0.5 mm** (**0.0197 in**), measured between the rim edges.

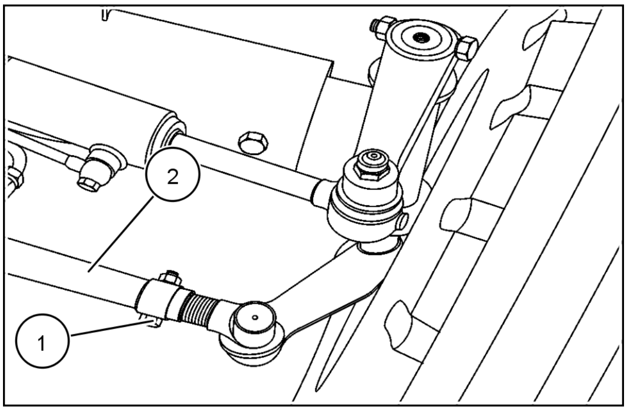
Check the correct toe-in as follows:

1. Inflate front tires to a pressure of **172 kPa** (**25 psi**).
2. Place the steering wheel at mid-travel, with one spoke along the tractor center line.
3. Check if wheels are parallel to the tractor center line.
4. Measure the distance (B) between the wheel inner rims at hub height at the front of the wheels.
5. Measure the distance between the wheel inner rims at hub height at the rear of the wheels. The measurement taken should be the same as (B) or greater by up to (A =B + 0 to **5 mm** (**0.197 in**))



20097805 2

6. If necessary to adjust the front wheel toe-in, proceed as follows:
   - Loosen the clamp, **(1)**, on both end of the track control rod.
   - Turn the track control rod, **(2)**, in or out to shorten or lengthen the track control rod until **0.5 mm** (**0.0197 in**) toe-in is achieved.
   - Tighten the clamp, **(1)**.



20099965 3

FRONT AXLE - Remove - 4WD

⚠ DANGER ⚠

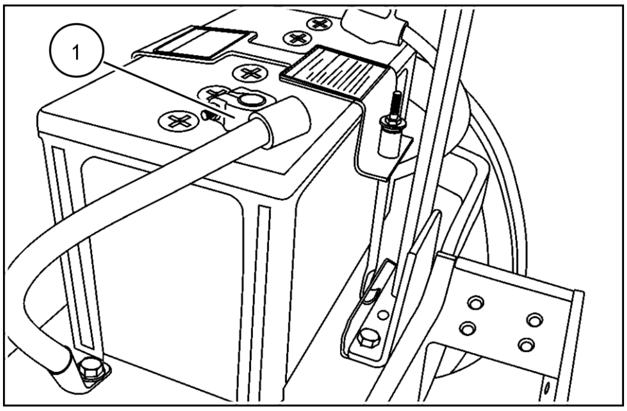
Lift and handle all heavy components using lifting equipment of appropriate lifting capacity. Make sure that units or parts are supported by suitable slings or hooks. Make sure that no-one is in the vicinity of the load to be lifted. Failure to comply could result in serious injury or death.

B012

Proceed as follows:

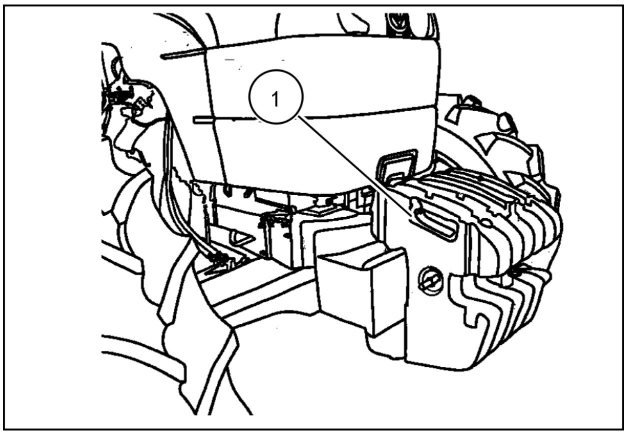
NOTE: *The front axle assembly can be removed from the tractor either with or without previously removing the drive shaft. The description below refers to removal of the front axle with the drive shaft installed on the tractor.*

1. Disconnect the negative battery lead, **(1)**.



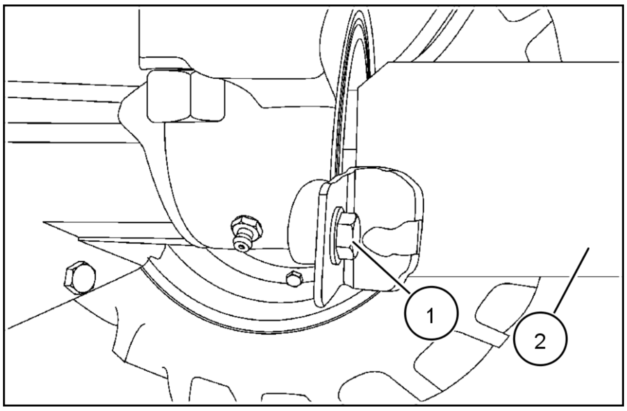
20099930 1

2. Attach nylon slings to the front weights, **(1)**. Loosen the locking screw from each weight, lift the weights clear of the tractor and place them in a safe position.



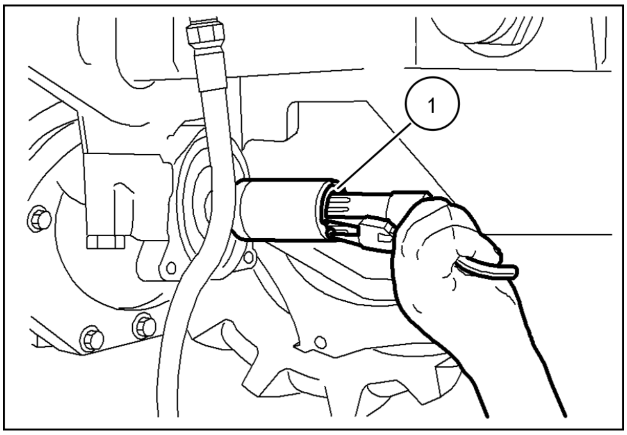
20097655 2

3. Remove the bolts, **(1)**, and remove the drive shaft guards, **(2)**.



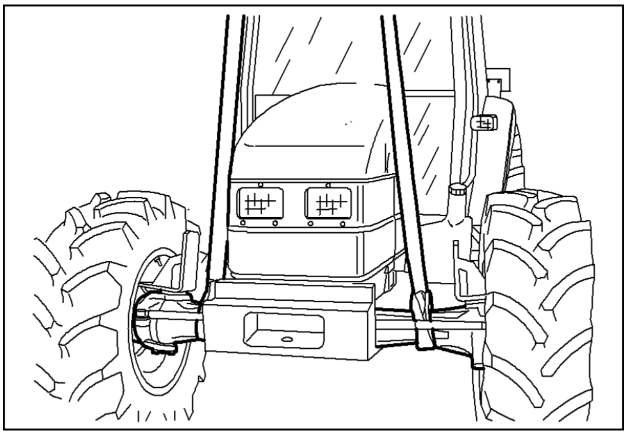
96096504 3

4. Remove the snap ring, **(1)**, from the front and rear of the drive shaft.
5. Remove the bolts from the drive shaft support.
6. Remove the drive shaft from the front axle input shaft and drop box output shaft by sliding the two couplers onto the drive shaft.



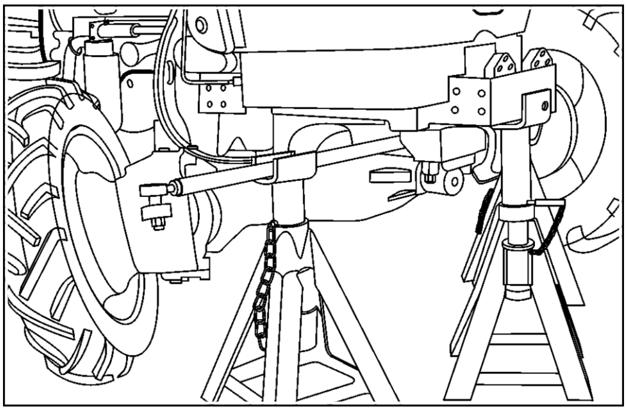
20097657 4

7. Attach nylon slings around the front axle and attach them to a hoist.



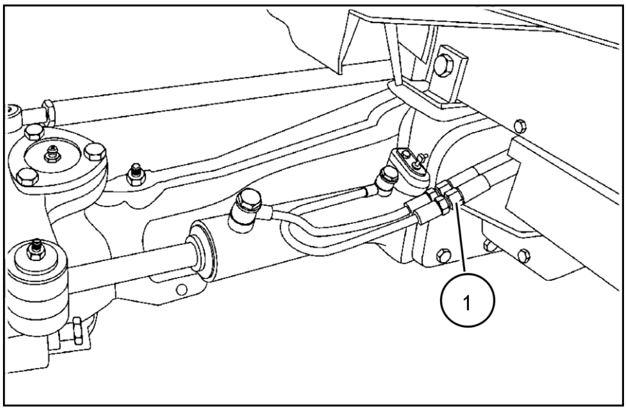
20097658 5

8. Lift the tractor with the hoist and place a stand under the lower portion of the front axle.



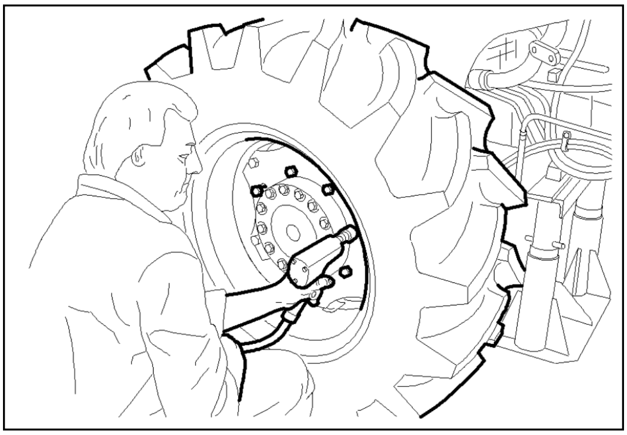
20099978 6

9. Remove the power steering hoses, **(1)**, from the power steering tubes.



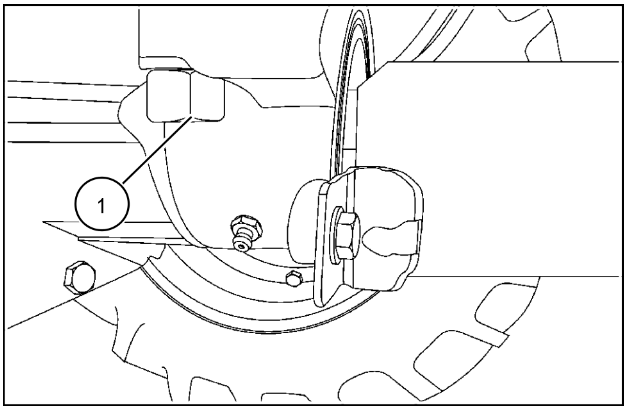
96096507 7

10. Remove the front wheels.



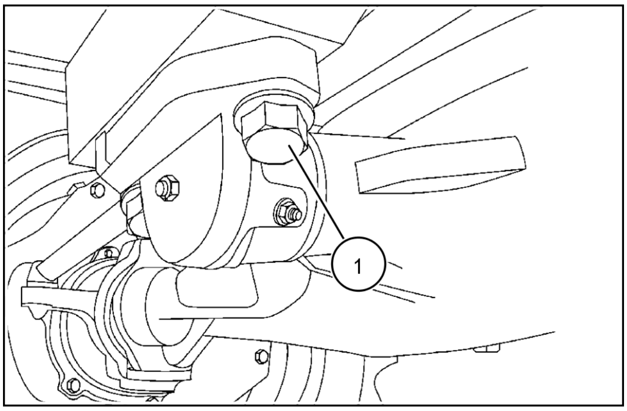
20097661 8

11. Remove the front axle rear support retaining bolts, **(1)**.



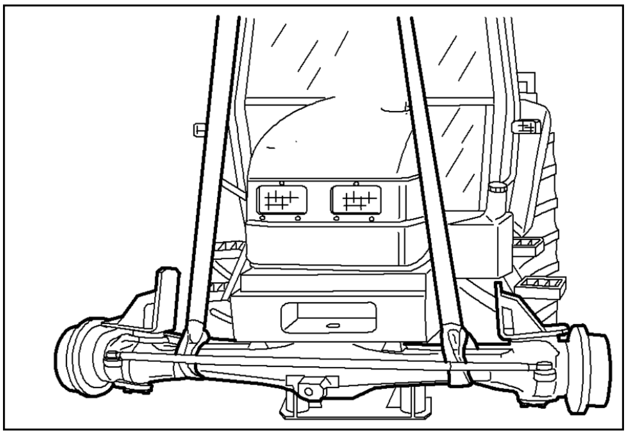
96096504 9

12. Remove the front axle front support retaining bolts, **(1)**.



96096506 10

13. Using a hoist and nylon cables (one for each side) detach the front axle from the tractor.



20097664 11

FRONT AXLE - Install - 4WD

Prior operation:
FRONT AXLE - Assemble (D.10.A)

1. Refit the front axle following the instructions below.

⚠ **WARNING** ⚠

Always use suitable tools to align holes. DO NOT USE HAND OR FINGERS. Failure to comply could result in death or serious injury.

B020A

- Install the axle and bolt the front and rear supports in position.
- Reconnect the power steering hoses.
- Install the front wheels.
- Raise the front of the tractor using the hoist.
- Remove the fixed stand.
- Detach the nylon cables.
- Reconnect the drive shaft and install the drive shaft guard.
- Attach a nylon cable to the front weights, lift, install to the tractor and secure with the locking screws.
- Reconnect the negative battery lead.
- Refer to the tightening torques **FRONT AXLE - Torque - 4WD (D.10.A)**.

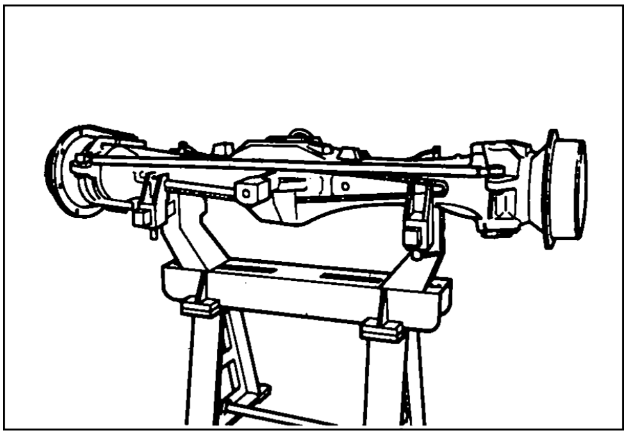
FRONT AXLE - Disassemble - 4WD

Prior operation:
FRONT AXLE - Remove (D.10.A)

⚠ WARNING ⚠

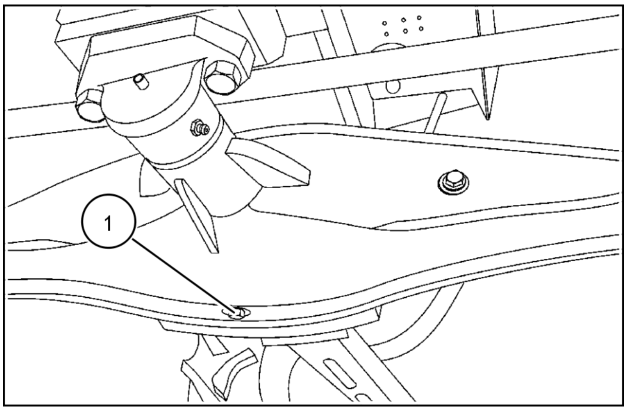
Handle all parts carefully. Do not put your hands or fingers between parts. Always wear suitable safety items such as fitted clothing, safety goggles, gloves, shoes, etc. Failure to comply could result in death or serious injury.

M954A



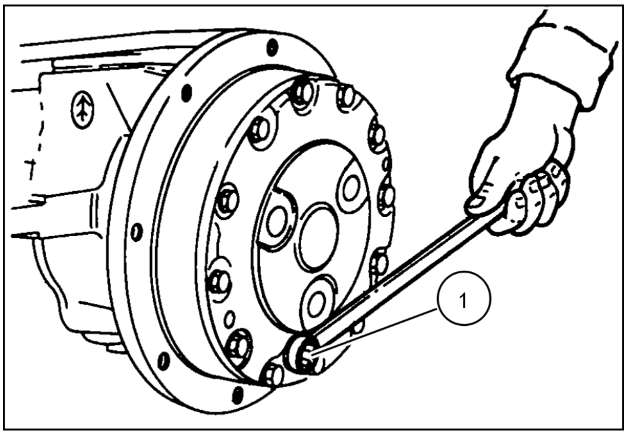
20097665 1

1. Remove plug, **(1)**, and drain the oil from the axle casing.



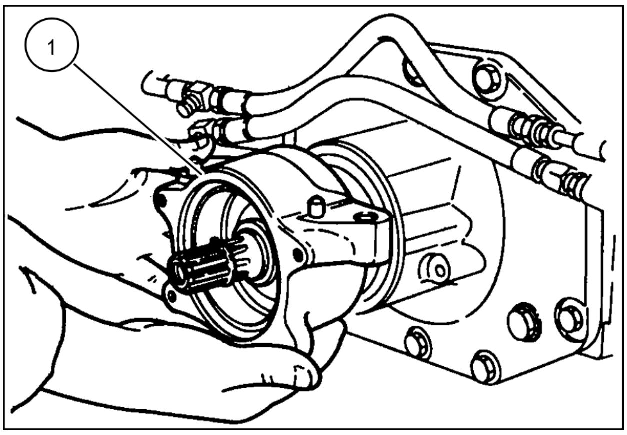
96096503 2

2. To drain the final drive oil, remove plug, **(1)**, on the left-hand final drive casing; repeat the same operation on the right-hand casing.



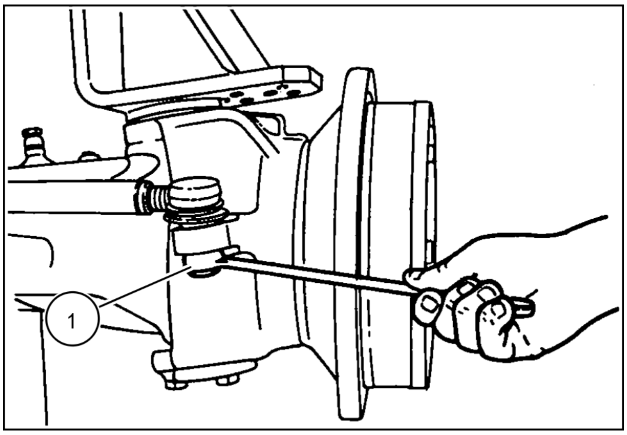
20097667 3

3. Remove the rear support, **(1)**, off the front axle; remove the front support and the thrust washer.



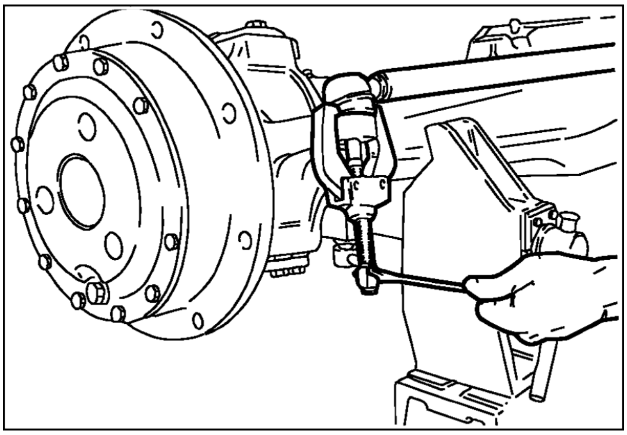
20097668 4

4. Remove the tie rod retaining nuts, **(1)**.



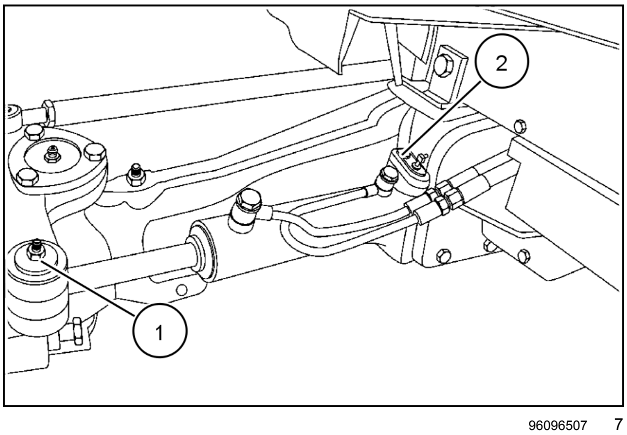
20097669 5

5. Using a removal tool, remove the tie rod ends from their bores in the stub axle housing.



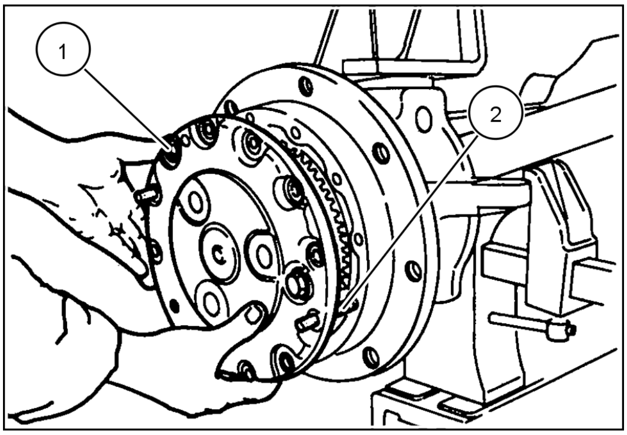
20097670 6

6. Remove the snap ring from the bottom of the cylinder rod pivot pin, **(1)**, remove the pin retaining bolt, **(2)**, from the pin. Remove the pins and detach the cylinder.



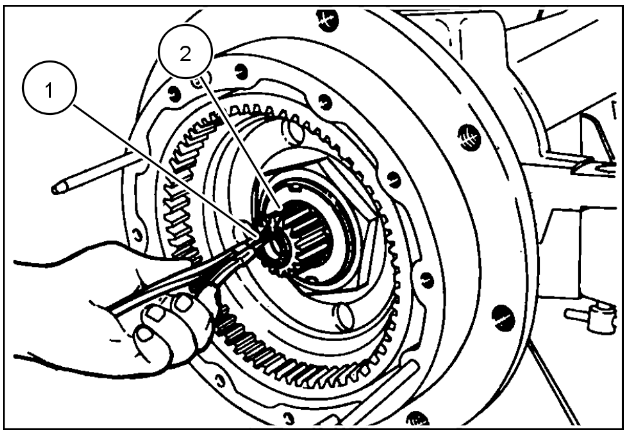
96096507 7

7. Unscrew the retaining bolts off the left-hand final drive casing cover, **(1)**. Screw in the two M10 x 100 dowels tool no 380002813, **(2)**, and, using a slide hammer puller screwed into the oil drain plug, detach the cover, **(1)**, from the casing.



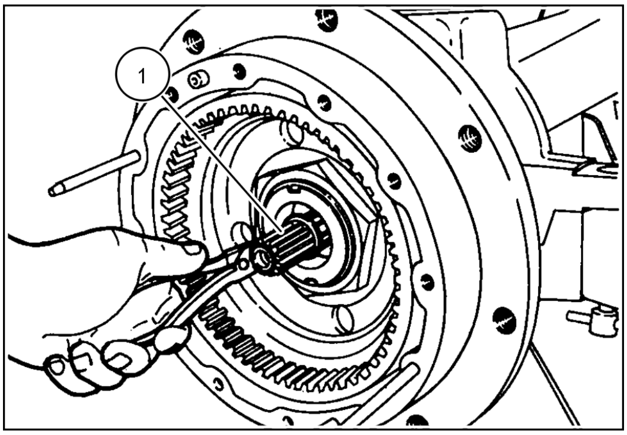
20097672 8

8. Remove the snap ring, **(1)**, securing the driving gear, **(2)**, and remove the gear.



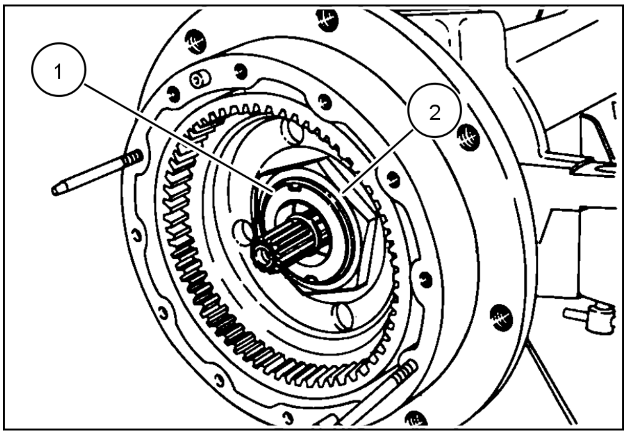
20097673 9

9. Remove the snap ring, **(1)**, securing the driving gear.



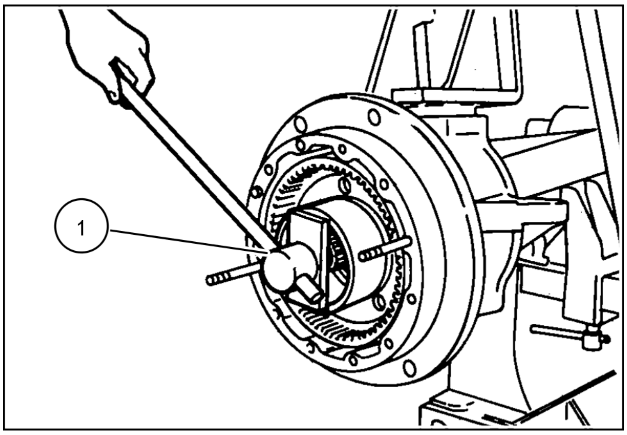
20097674 10

10. Remove the staking, **(1)**, on the wheel hub bearing lock ring, **(2)**.



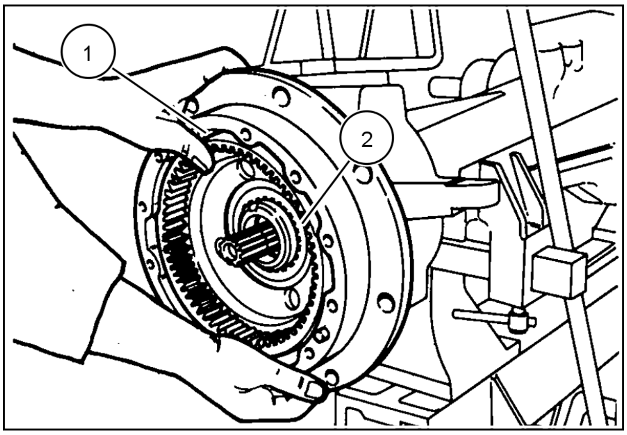
20097675 11

11. Remove the wheel hub bearing lock ring using tool no **380000295**, **(1)**.



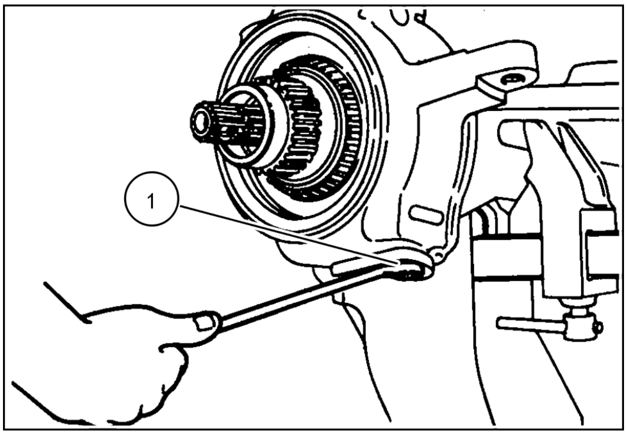
20097676 12

12. Remove the wheel hub, **(1)**, with the ring gear, **(2)**.



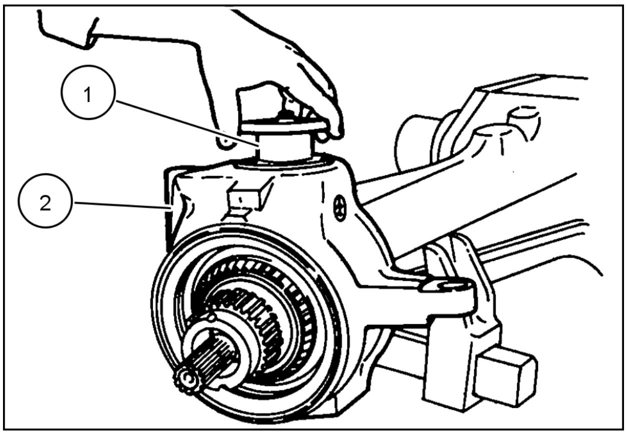
20097677 13

13. Remove the retaining bolts, **(1)**, of the lower pivot pin of the stub axle housing. Remove the lower pivot pin and the relative adjustment shims.



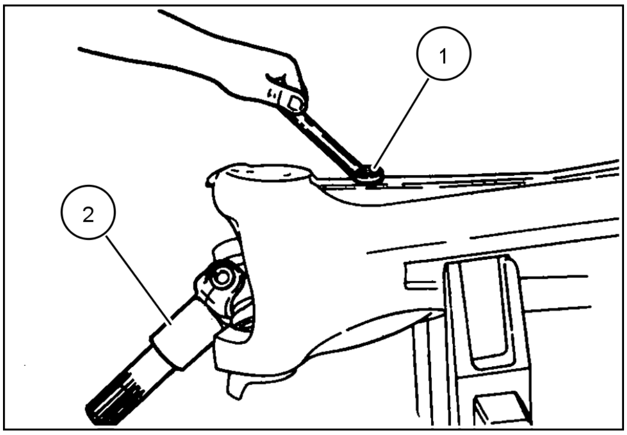
20097678 14

14. Remove the retaining bolts of the upper pivot pin.
15. Withdraw the upper pivot pin, **(1)**, and detach the stub axle housing, **(2)**.



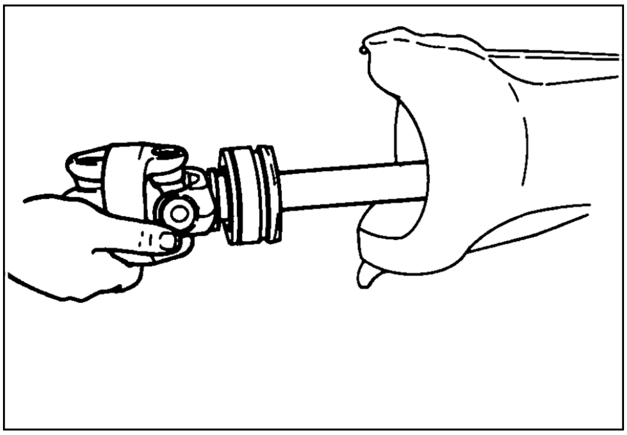
20097679 15

16. Remove the retaining bolt, **(1)**, of the axle shaft, **(2)**.



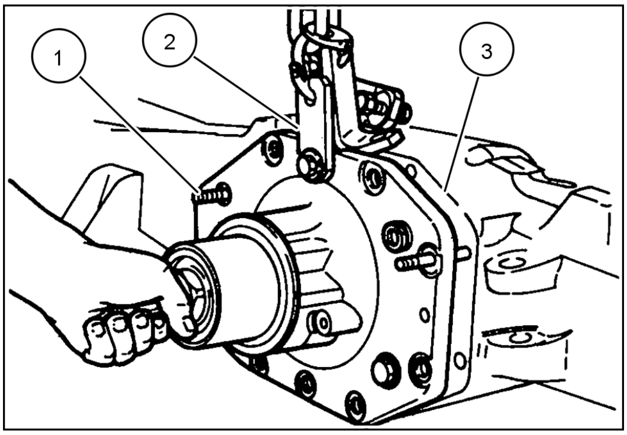
20097680 16

17. Using a prybar, pull the axle shaft out of the casing.
18. To disassemble the right-hand final drive unit, repeat the above steps 7 to 17.



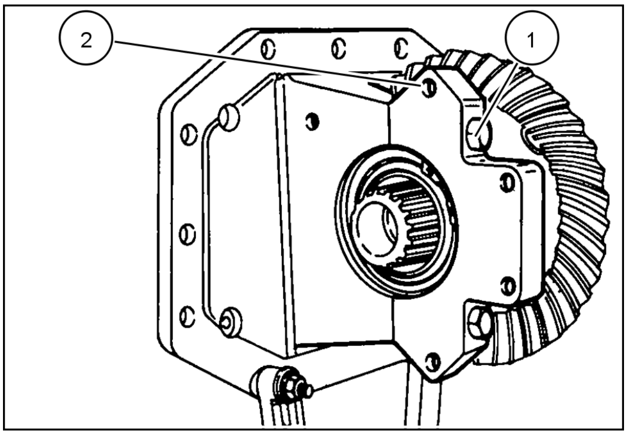
20097681 17

19. Remove the bolts fixing the bevel drive-differential support to the axle casing. Screw in the M12 x 100 dowels, tool no 380002814, **(1)**. Remove the remaining bolts and separate the bevel drive-differential support from the axle casing. Attach a chain, **(2)**, to the support and take up the weight with the hoist. Remove the bevel drive-differential support, **(3)**, from the axle casing.



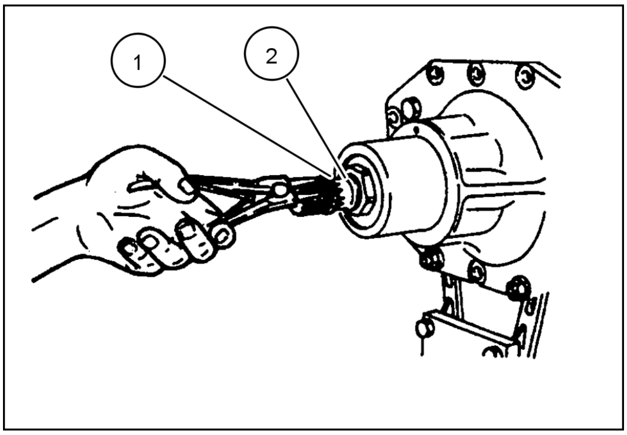
20097682 18

20. Remove the two bolts, **(1)**, from the two ring gear differential support caps, **(2)**. Remove the crown wheel-differential assembly from the housing.



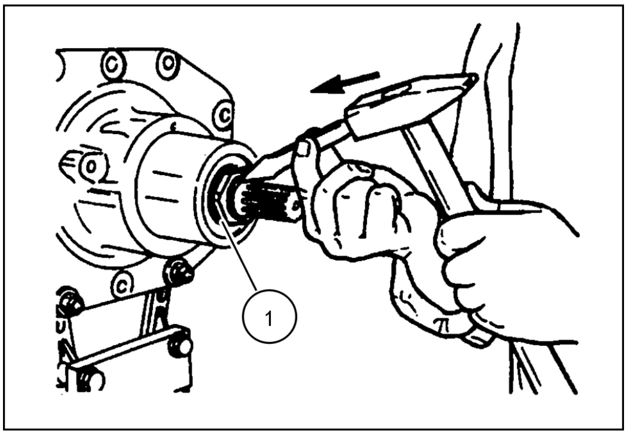
20097683 19

21. Remove the snap ring, **(1)**, from the splined shaft, **(2)**.



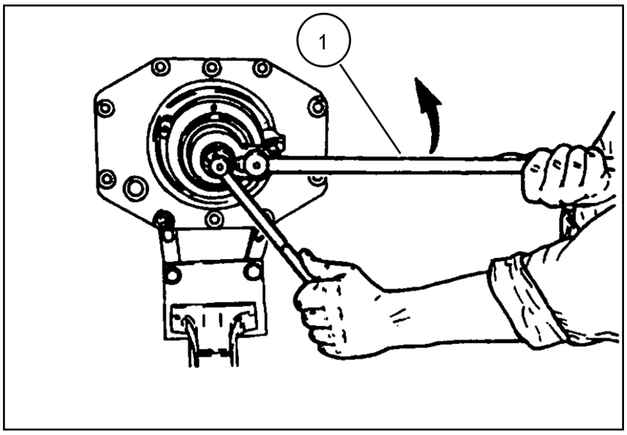
20097684 20

22. Straighten the locking tab on the splined shaft lock nut, **(1)**.



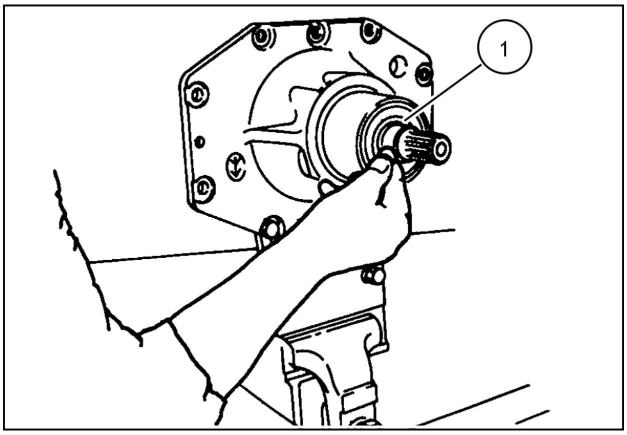
20097685 21

23. Remove the nut using wrench, tool no **380000268**, **(1)**, while holding the bevel drive pinion shaft against rotation with wrench, tool no **380000257**.



20097686 22

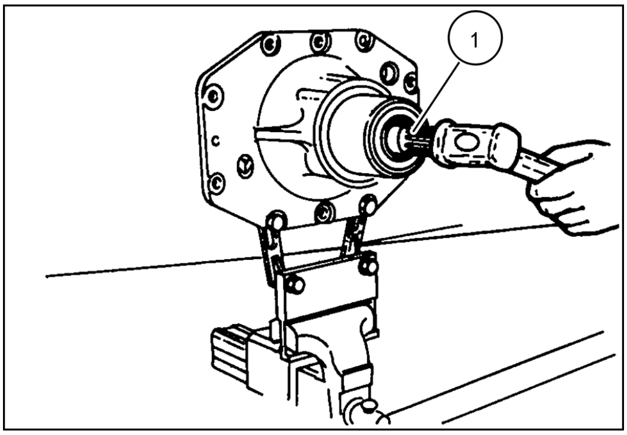
24. Remove the splined shaft detent ball, **(1)**.



20097687 23

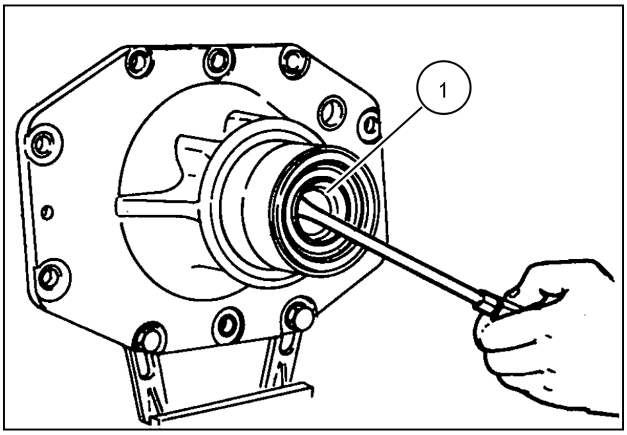
25. Remove the bevel drive pinion shaft, **(1)**, from the rear of the casing and remove the spacer, the adjustment shims and the bearing.

NOTE: *Observe the quantity and the size of the shims removed from the pinion shaft.*



20097688 24

26. Using a screwdriver, remove the dust seal, seal ring, **(1)**, and rear bearing.



20097689 25

Next operation:
FRONT AXLE - Inspect - 4WD (D.10.A)

FRONT AXLE - Inspect - 4WD

Prior operation:
FRONT AXLE - Disassemble - 4WD (D.10.A)

1. Wash all parts in a suitable solvent and allow to air dry.
2. Inspect the gears for excess wear or damage. Replace as necessary.
3. Check all the bearings for wear or roughness. Rotate the bearings by hand and replace as necessary.
4. Inspect the axle shafts and pinion shaft for wear or damage. Replace as necessary.
5. Inspect the front axle housing for any damage. Replace as necessary.

Next operation:
FRONT AXLE - Assemble - 4WD (D.10.A)

FRONT AXLE - Assemble - 4WD

Prior operation:
FRONT AXLE - Inspect - 4WD (D.10.A)

1. Reassemble the front axle adhering to the following instructions:
    - Refer to the tightening torques **FRONT AXLE - Torque - 4WD (D.10.A)**
    - Install the rear bearing, the seal, the dust seal, the adjustment shims, the spacer and the bevel drive pinion shaft complete with front bearing.
    - Position the detent ball, screw in the bevel drive pinion lock nut and secure in position by staking. Finally, replace the snap ring.
    - Install the ring gear differential assembly, the support caps and tighten the relative bolts.
    - Install the bevel drive-differential housing on the front axle casing.
    - Install the axle shaft and relative bolt.
    - Install the stub axle, the adjustment shims, the upper and lower pivot pins.
    - Install the wheel hub, the ring gear of the final drive unit and the lock ring and tighten to the prescribed torque value, while simultaneously turning the wheel hub to ensure that the bearings are correctly seated.
    - Install the securing and stop snap rings, the driving gear and the cover of the final drive unit.
    - Install the pins, washers, spacers and steering cylinders.
    - Install the track rod, the front and rear supports and the oil drain plugs.

Next operation:
FRONT AXLE - Install (D.10.A)

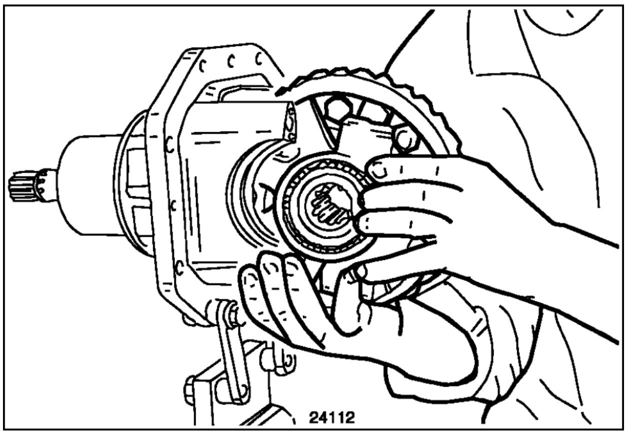
FRONT AXLE - Adjust - 4WD Ring/pinion adjustment

Prior operation:
Differential - Adjust - 4WD Bevel drive adjustment (D.10.A)

Adjustment of the ring gear bearings and checking the backlash between the pinion and ring gear

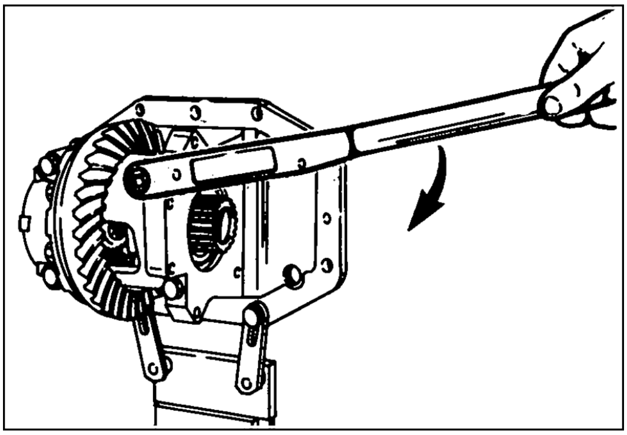
Proceed as follows.

1. Install the differential assembly complete with ring gear and inner ring gear bearing rings in the bevel drive/differential housing.



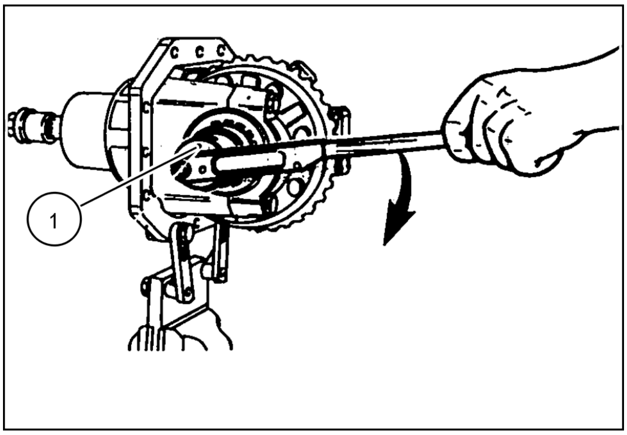
20097705 1

2. Insert the outer bearing rings in the differential housing, install the differential support caps, tighten the bolts to a torque of **59 N·m** (**44 lb ft**), then loosen and re-tighten to a torque of **20 N·m** (**15 lb ft**).



20097706 2

3. With the bearings lubricated, rotate the ring gear and at the same time tighten the threaded adjustment ring using wrench, tool no **380000252**, **(1)**, to a torque of **39 - 59 N·m** (**29 - 44 lb ft**) to take up the axial play between the components.

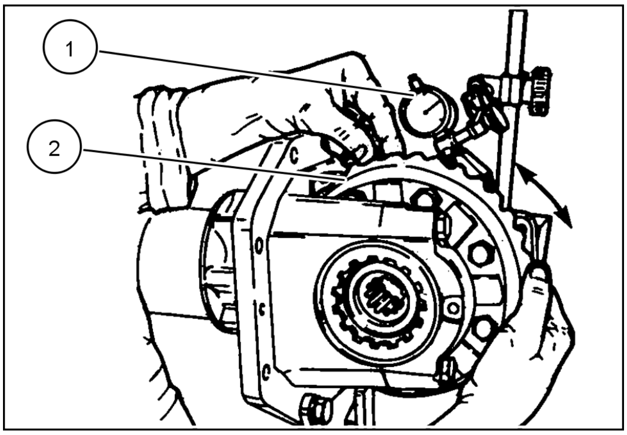


20097707 3

4. Measure the backlash between pinion and ring gear, using a dial gauge, **(1)**, perpendicular to the outer edge of a tooth on the ring gear, **(2)**.

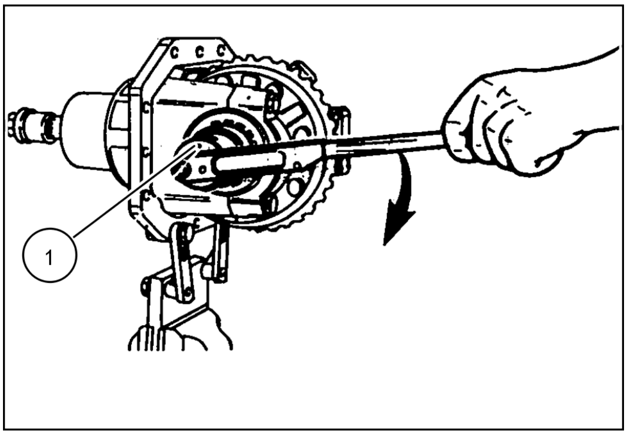
5. Repeat the measurement in two other positions 120° apart and compare the average of the three values (Gm) with the prescribed normal backlash specification of: **0.18 mm** (**0.007 in**) - **0.23 mm** (**0.009 in**) average value **0.20 mm** (**0.008 in**).

   If the measured backlash exceeds the prescribed value, adjust the threaded adjustment rings by screwing one of the rings in and the other out by the same amount to correct the axial preload and thus obtain the prescribed backlash.



20097708 4

6. With a dial gauge positioned perpendicular to the outside edge of one of the ring gear teeth, check that the backlash between the pinion and ring gear is within the tolerance limits of **0.18 mm** (**0.007 in**) - **0.23 mm** (**0.009 in**).



20097707 5

7. Using a wrench, tool number **380000252**, **(1)**, turn the threaded adjustment ring and check, using torque wrench, **(2)**, that the combined rolling resistance torque of the ring gear and pinion bearings is:

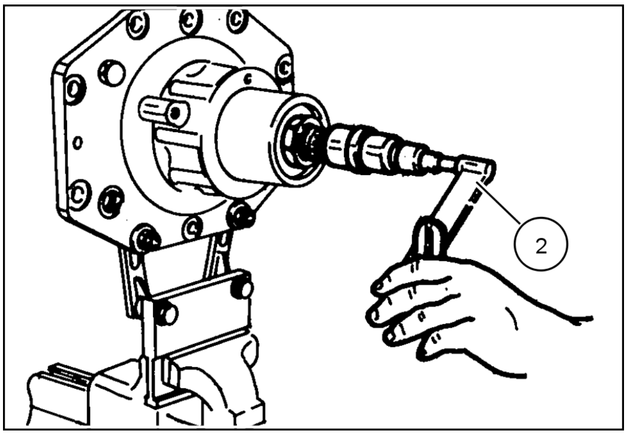
   A2 = A1 + **1.0 N·m** (**0.74 lb ft**) to **1.5 N·m** (**1.11 lb ft**).

   where:

   A2 = combined ring gear/pinion rolling resistance torque;

   A1 = rolling resistance torque of pinion only as measured previously **Differential - Adjust - 4WD Bevel drive adjustment (D.10.A)**.

   1.0 N·m (**0.74 lb ft**) to **1.5 N·m** (**1.11 lb ft**) = rolling resistance torque of crown wheel only measured at the end of the pinion using wrench, tool number **380000257** and a torque wrench.



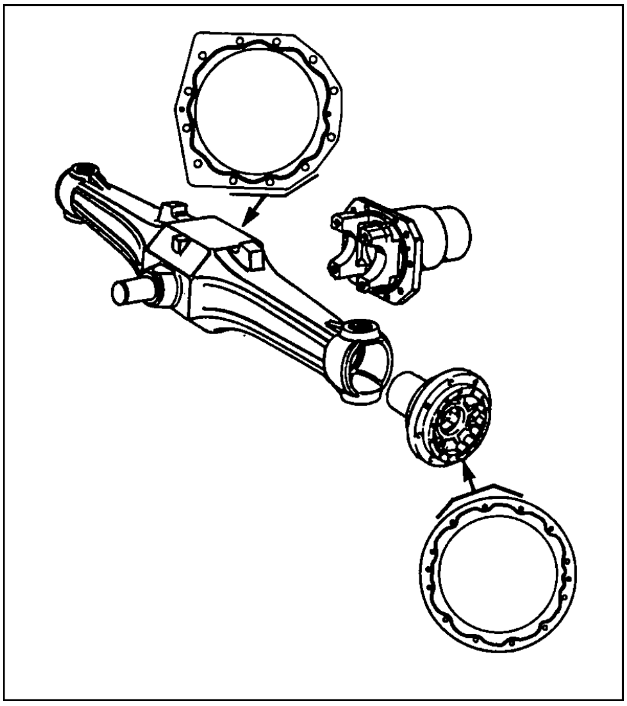
20097709 6

8. Tighten the cap bolts see figure in **FRONT AXLE - Torque (D.10.A)** to a torque of **113 N·m** (**83 lb ft**).

9. Install the safety plate, screwing the threaded adjustment ring in or out up to the nearest notch.

10. Attach the bevel drive/differential to the axle casing after having carefully cleaned and degreased the mating surfaces and applied a bead of gasket eliminator **LOCTITE® 518**, approx. **2 mm** (**0.08 in**) wide along the line shown in the figure.

11. Gasket eliminator **LOCTITE® 518** application diagram for assembly of bevel drive unit and epicyclic final drive unit.



20097711 7

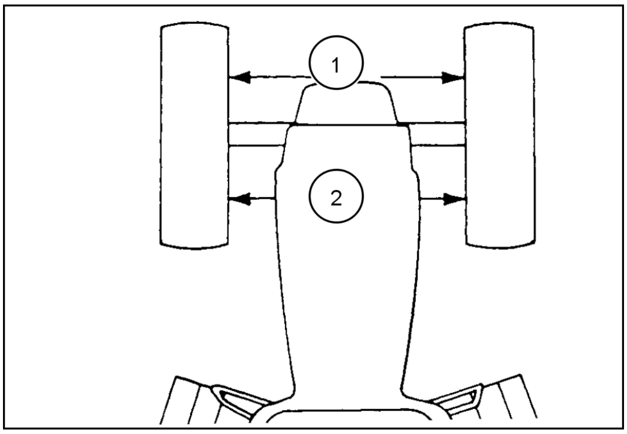
FRONT AXLE - Adjust - 4WD Toe in adjustment

When travelling forward in a straight path, the wheels of four-wheel drive tractors must be parallel to the longitudinal axis of the tractor, alternatively a slight toe-in of the front wheels is permissible up to a maximum of **6 mm** (**0.24 in**) as measured at the edges of the wheel rims.

To check the exact value of the toe-in setting of four-wheel drive tractors, proceed as follows.

1. Inflate the front tires to the prescribed pressure.
2. Position the steering at the straight ahead position (along the longitudinal axis of the tractor).
3. Check that the wheels are parallel to the longitudinal axis of the tractor.
4. Make a chalk mark on the front inside edges of both wheel rims, at the height of the wheel hub centers. Measure the distance, **(1)**, between the chalk marks.
5. Move the tractor forward to turn both front wheels through **180 °**The chalk marks will now be measure between the rear inside edges of the wheel rims at the height of the wheel hub centers. Now measure the distance, **(2)**, checking that this new measurement is equal to or greater than the distance, **(1)**, by a maximum or **6 mm** (**0.24 in**).

   The rotation of the wheels through **180 °** is necessary to eliminate the effect of wear, misalignment or distortion of the wheel rims on the measurements obtained.



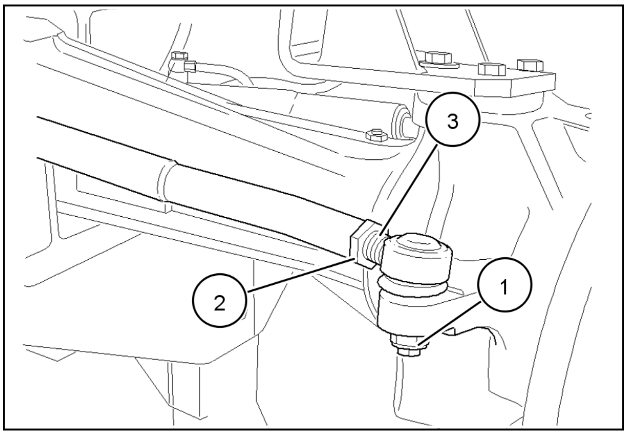
20097715 1

6. If it is necessary to correct the wheel alignment, remove nut, **(1)**, and pull the tie rod end out of its housing. Loosen the locknut, **(2)**, and screw the tie rod end, **(3)**, in or out to increase or decrease the distance, **(2)**,

   Reposition the tie rod end in its housing and re-check alignment.

   After having adjusted the toe in to within the prescribed limits, tighten locknut, **(2)**, to a torque of **180 N·m** (**133 lb ft**) and nut, **(1)**, to **100 N·m** (**74 lb ft**).

NOTE: *The self-locking nut,* ***(1)****, must be replaced each time it is removed or partially unscrewed.*



20097716 2

Axle - Adjust - Stub axle adjustment 4WD

Prior operation:
FRONT AXLE - Remove - 4WD (D.10.A)

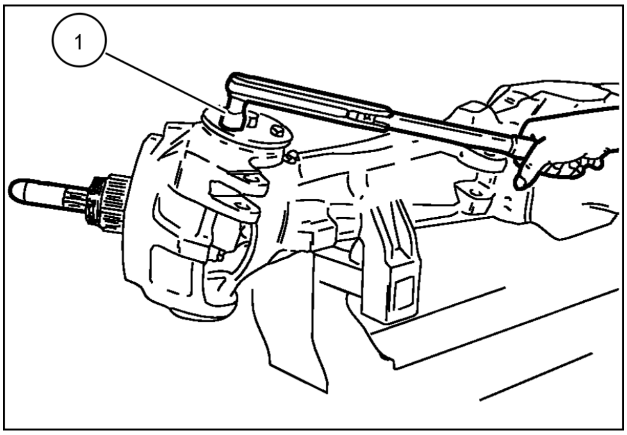
⚠ WARNING ⚠

Handle all parts carefully. Do not put your hands or fingers between parts. Always wear suitable safety items such as fitted clothing, safety goggles, gloves, shoes, etc. Failure to comply could result in death or serious injury.

M954A

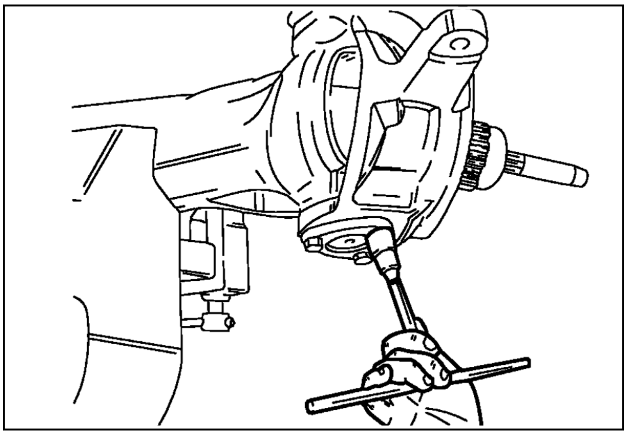
Install the front axle on a stand and proceed as follows.

1. Smear grease on the outer races of the bearings and fit the upper cover, without the adjustment plate, but with tool number **380000235**, **(1)**. Tighten the retaining bolts to a torque value of **64 N·m** (**47 lb ft**).



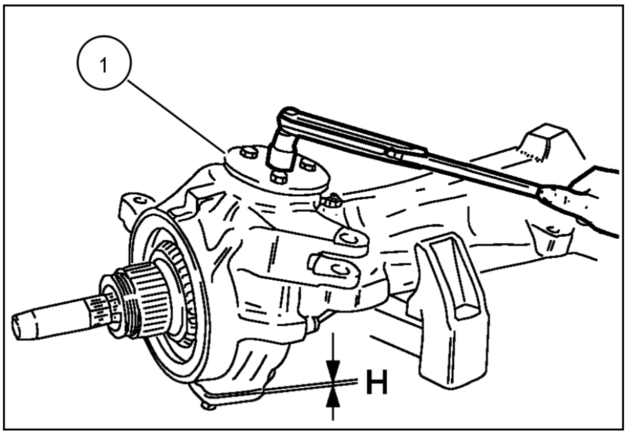
20097692 1

2. Install the lower cover without adjustment plate, lubricate the three retaining bolts with oil.
3. Gradually tighten the lower cover bolts in sequence, while simultaneously rotating the casing to allow the excess grease to escape.



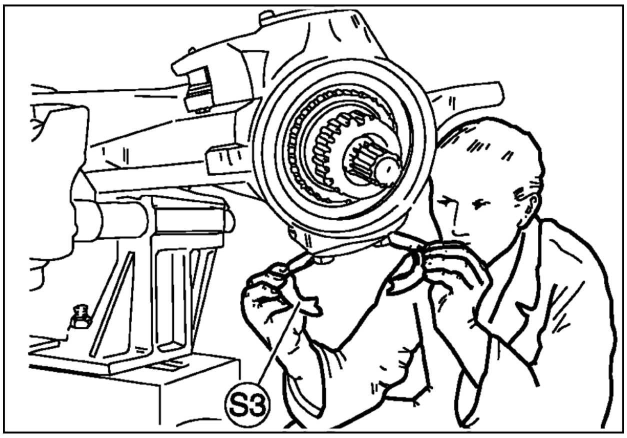
20097693 2

4. Using a torque wrench, tool number **380000235**, **(1)**, check that the torque required to rotate the casing is **2.9 N·m** (**25.7 lb in**),without considering the peak starting value. If not, adjust by way of the lower cover bolts.
5. Measure the gap (H) created between the low cover and the casing in correspondence with the three bolts.



20097694 3

6. Calculate the average of the three values measured. The total thickness of the adjustment shims to be fitted under the lower cover is to be calculated as follows:
   S3= H
   If necessary, round up the value to the next **0.05 mm** (**0.002 in**).
7. Partially unscrew the bolts of the lower cover, insert the shims and tighten the bolts to a torque value of **64 N·m** (**47 lb ft**).
8. After having rotated the casing a few times to allow the components to bed down, check that the torque necessary to rotate the casing is **2.9 N·m** (**25.7 lb in**) - **7.8 N·m** (**69 lb in**), without considering the initial peak torque.
9. If the torque value measured is greater than the prescribed value, increase the thickness of the shims, if the measured value is less than the prescribed value, reduce the thickness of the shims.
10. Install the grease nipples in the upper and lower covers and grease the assembly.



20097695 4

Next operation:
Hub - Adjust Wheel hub bearing adjustment 4WD (D.10.A)

Differential - Adjust - 4WD Front axle adjustment

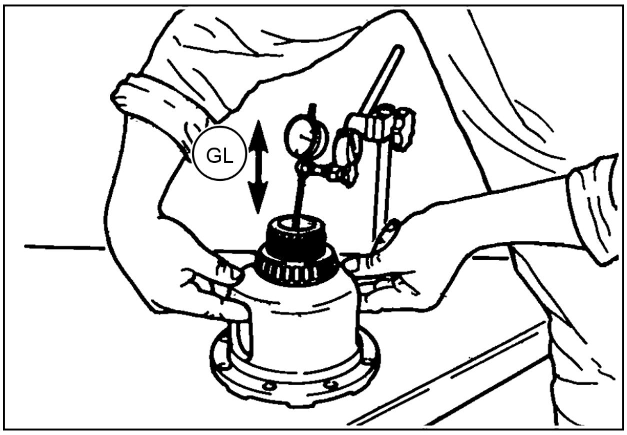
Prior operation:
FRONT AXLE - Disassemble - 4WD (D.10.A)

End Play Adjustment

In case of differential assembly overhaul it is necessary to adjust the backlash between the teeth of the planet pinions and side gears.

Proceed as follows:

1. Thoroughly clean the components of the differential to remove any traces of oil which would otherwise prevent accurate backlash measurement.
2. Install the two side gears without thrust washers.
3. Install the planet pinions complete with thrust washers and pins and screw the pin retaining bolts in by a few turns to hold the pins in place.
4. Position a dial gauge on the differential housing.
5. Move the left-hand side gear to bring it into full contact with the planet pinion and then push it up against the differential housing, reading the end play (GL) on the dial gauge.



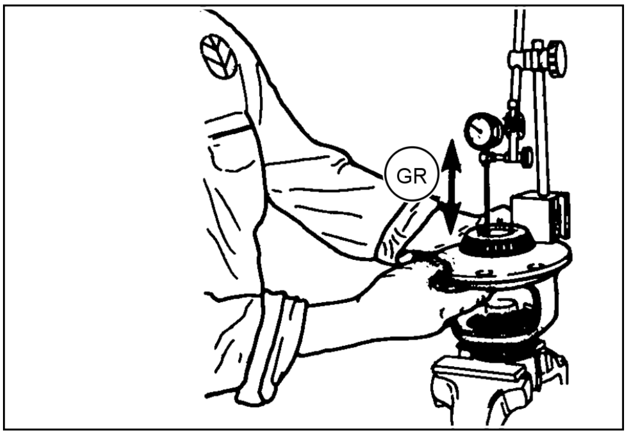
20097712 1

6. Repeat the above operations to measure the end play on the right-hand side gear (GR).

   The end play should be **0.25 mm** (**0.010 in**). Therefore the shims to be inserted in the differential housing are given by:

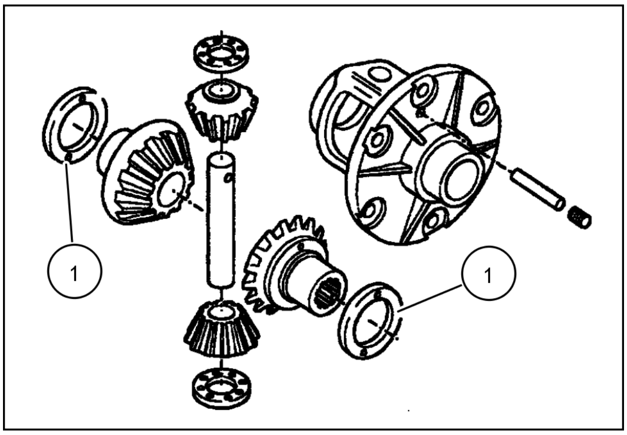
   Shim (left) = GL - **0.25 mm** (**0.010 in**) for the left-hand side gear.

   Shim (right) = GR - **0.25 mm** (**0.010 in**) for the right-hand side gear.



20097713 2

7. Install shims, **(1)**, as near as possible to the calculated value. Use a dial gauge and following the procedure described above, check that the end float of the left and right-hand side gears is approximately **0.25 mm** (**0.010 in**).



20097714 3

Differential side gear shim sizes

Available Shim Sizes mm (inches)	
1.0 mm (**0.039 in**)	**1.6 mm** (**0.063 in**)
1.1 mm (**0.043 in**)	**1.7 mm** (**0.067 in**)
1.2 mm (**0.047 in**)	**1.8 mm** (**0.071 in**)
1.3 mm (**0.051 in**)	**1.9 mm** (**0.075 in**)
1.4 mm (**0.055 in**)	**2.0 mm** (**0.039 in**)
1.5 mm (**0.059 in**)	

Bevel gear - Adjust - 4WD Bevel drive adjustment

Prior operation:
FRONT AXLE - Disassemble - 4WD (D.10.A)

Adjustment of the Preload of the Pinion Shaft Bearings

⚠ WARNING ⚠

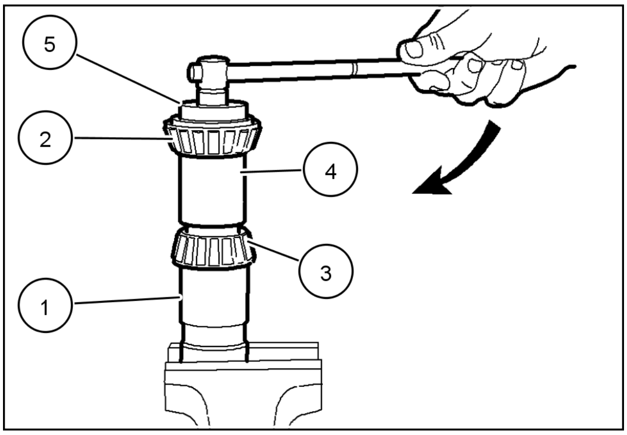
Handle all parts carefully. Do not put your hands or fingers between parts. Always wear suitable safety items such as fitted clothing, safety goggles, gloves, shoes, etc. Failure to comply could result in death or serious injury.

M954A

Proceed as follows.

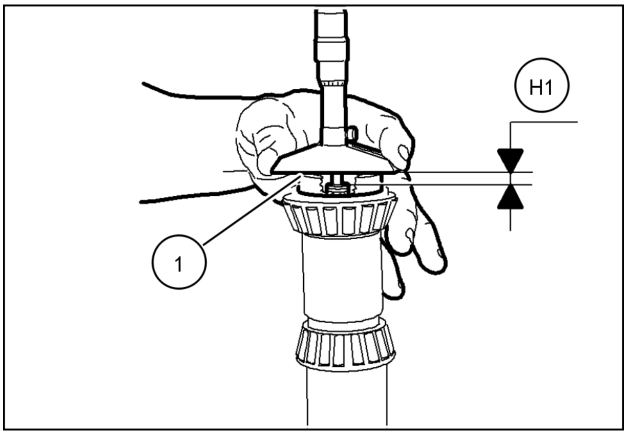
1. Clamp tool no **380000248**, **(1)**, in the vice, install bearings, **(2)** and **(3)**, and the bearing spacer, **(4)**, and tighten the nut of the tool fully home.

NOTE: *Install the* ***10 mm*** *(****0.394 in****) thick spacer between tool no* ***380000248****,* ***(1)****, and the bearing,* ***(2)****.*



20097697 1

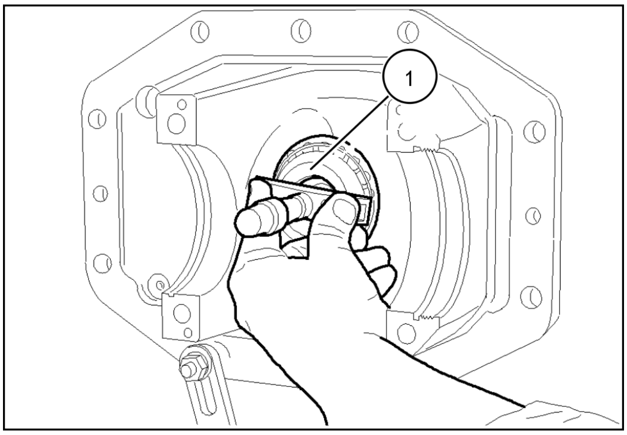
2. Using a micrometer, measure distance **(H1)** between the upper surface and the pin of tool no **380000248**, **(1)**.
3. Disassemble the above parts, lubricate the bearings with oil and then re-assemble the parts, excluding the bearing spacer, in the bevel drive-differential housing, complete with outer bearing races, held in place with tool no **380000255**.



20097698 2

4. Tighten the nut of tool no **380000255**, **(1)**, while turning the tool to ensure that the bearings are seated correctly.
5. Using a micrometer, measure the distance **(H2)** between the upper surface and the pin of the tool.
6. The thickness of the adjustment shim required is given by:

   Shim = H2 - H1 + **0.05 mm** (**0.002 in**)

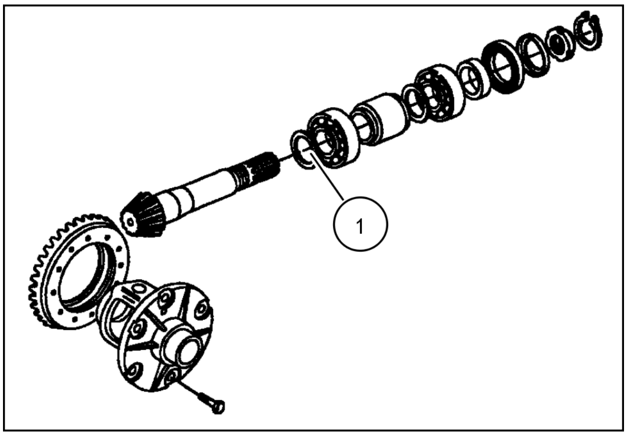


20097699 3

If necessary, round the value thus obtained up to the nearest **0.05 mm** (**0.002 in**).

Pinion positioning shim, **(1)**, is located between pinion gear and front bearing.

NOTE: *On completing the adjustment, do not remove the adjustment tool from the bevel drive-differential housing: leave in place for adjustment of the drive pinion position.*



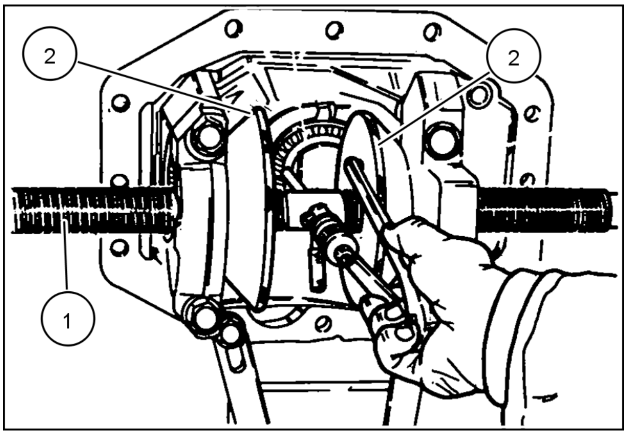
20097700 4

Available Shim Sizes mm (inches)	
0.5 mm (**0.020 in**)	**2.7 mm** (**0.106 in**)
2.5 mm (**0.098 in**)	**2.8 mm** (**0.110 in**)
2.6 mm (**0.102 in**)	**2.9 mm** (**0.114 in**)

Determining the Thickness of the Drive Pinion Position Adjustment Shim

Proceed as follows.

7. Install tool number **380000249**, **(1)**, in the bevel drive-differential housing complete with outer bearing rings, ring gear bearings adjustment ring, ring gear bearings adjustment shim, circlip and differential support caps.
8. Screw the cones, **(2)**, of tool number **380000249**, **(1)**, in or out in order to orientate the micrometer shaft inline with the inner bearing ring while eliminating the end play between the cones and the outer rings of the ring gear bearings.
9. Adjust the micrometer so that the shaft is in contact with inner bearing race and measure the distance (H3) thus obtained.



20097701 5

10. Determine the correct distance (H5) between the ring gear axis and the large diameter base of the pinion:

    H5 =H4 ± C

    where:

    H4 = **95 mm** (**3.74 in**) nominal distance between the ring gear axis and the large diameter base of the pinion.

    C= correction value stamped on pinion preceded by a + or - sign, (if other than 0), to be added to or subtracted from the nominal distance (H4) according to the sign.

11. The thickness of the adjustment shim will be given by:

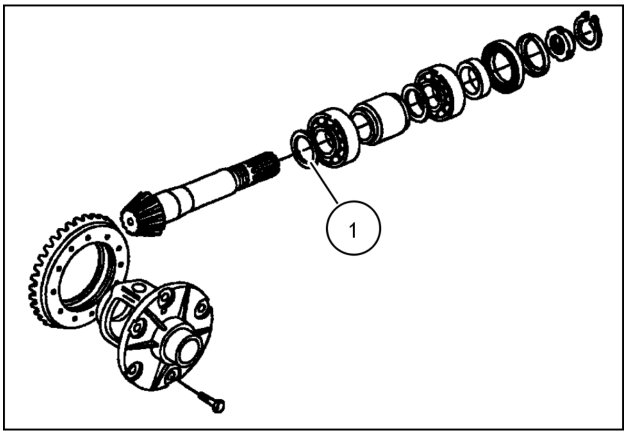
    Shim = H3 - H5

    where:

    H3 = the distance measured using the micrometer.

    H5 = corrected nominal distance between the crown wheel axis and the large diameter base of the pinion.
12. Remove tool number **380000248** and tool number **380000249** from bevel drive housing.
13. Install the drive pinion complete with: inner bearing races, spacer and adjustment shims of the previously determined thickness.

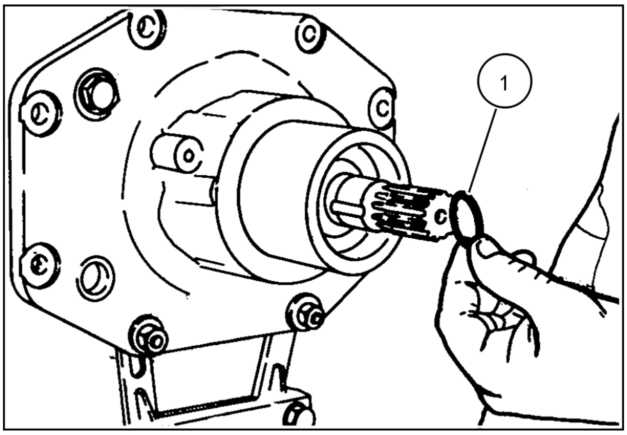
Pinion Bearing Preload shim, **(1)**, is located between spacer and rear bearing.



20097700 6

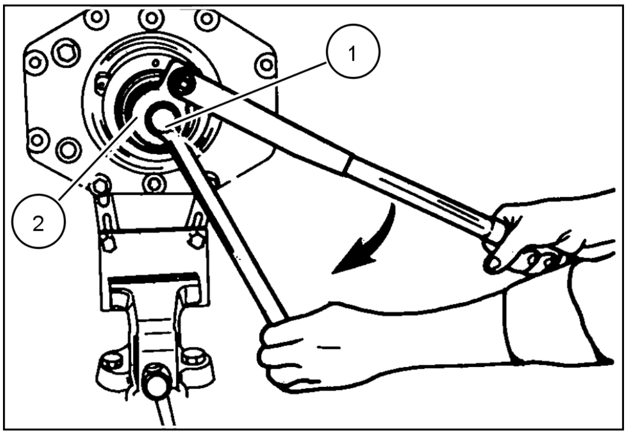
Available Shim Sizes mm (inches)	
0.5 mm (0.020 in)	**2.75 mm (0.108 in)**
2.5 mm (0.098 in)	**2.8 mm (0.110 in)**
2.55 mm (0.100 in)	**2.85 mm (0.112 in)**
2.6 mm (0.102 in)	**2.9 mm (0.114 in)**
2.65 mm (0.104 in)	**2.95 mm (0.116 in)**
2.7 mm (0.106 in)	

14. Install the O-ring seal, **(1)**, on the drive pinion shaft.
15. Then insert the spacer and then the detent ball, after having carefully lubricated the outer surface.



20097702 7

16. Install the pinion lock tool, tool number 380000257, **(1)**.
17. Install wrench, tool number **380000268** on the threaded adjustment ring.
18. Using a wrench on the pinion lock tool, **(1)**, hold the pinion against rotation, and using a torque wrench positioned exactly as shown in the figure on the threaded adjustment ring wrench, **(2)**, tighten the adjustment ring to a torque value of **294 N·m** (**217 lb ft**) while simultaneously rotating the pinion shaft to ensure that the bearings are seated correctly.



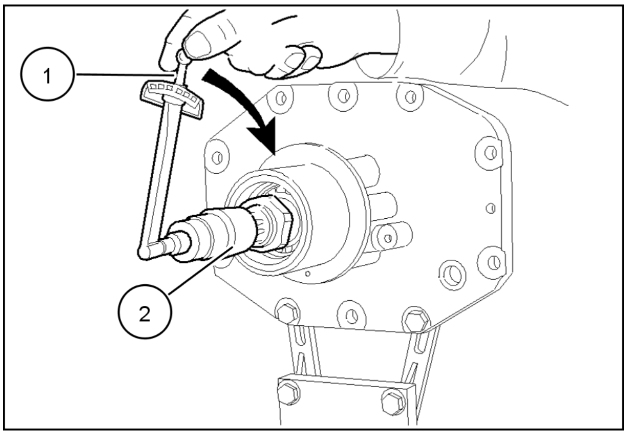
20097703 8

19. With a torque wrench, **(1)**, on the pinion lock tool, tool number **380000257**, **(2)**, check that the pinion rolling torque, without oil seal and relative dust seal ring, is **0 N·m** (**0 lb in**) - **0.2 N·m** (**1.8 lb in**).

    If the rolling torque is less than the prescribed value, install a thinner adjustment shim shown in Figure **6**, if the torque is greater than the prescribed value, install a thicker adjustment shim.

20. Unscrew the threaded adjustment ring and install the oil seal and the dust seal ring. Tighten the threaded ring to a torque of **294 N·m** (**217 lb ft**), while simultaneously rotating the pinion shaft to ensure that the bearings are seated correctly.
21. With a inch/pound torque wrench, **(1)**, on the pinion lock tool number **380000257**, **(2)**, check that the pinion rolling torque with the oil seal and relative dust seal ring is **0.5 N·m** (**4.4 lb in**) - **1 N·m** (**9 lb in**).

    Finally, carefully stake the threaded ring and fit the circlip on the drive pinion shaft.



20097704 9

Next operation:
FRONT AXLE - Adjust - 4WD Ring/pinion adjustment (D.10.A)

Spindle drive - Remove - 2WD

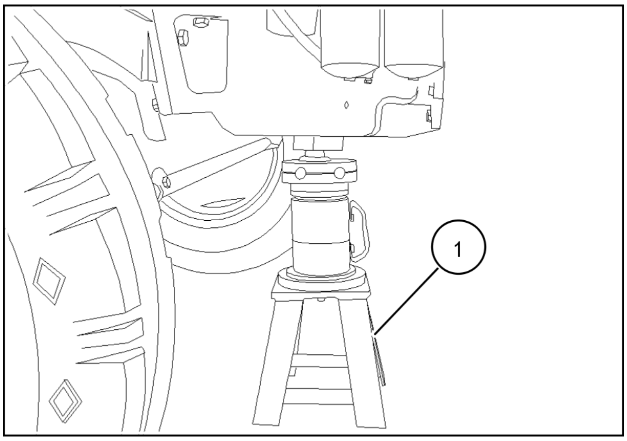
⚠ WARNING ⚠

Handle all parts carefully. Do not put your hands or fingers between parts. Always wear suitable safety items such as fitted clothing, safety goggles, gloves, shoes, etc. Failure to comply could result in death or serious injury.

M954A

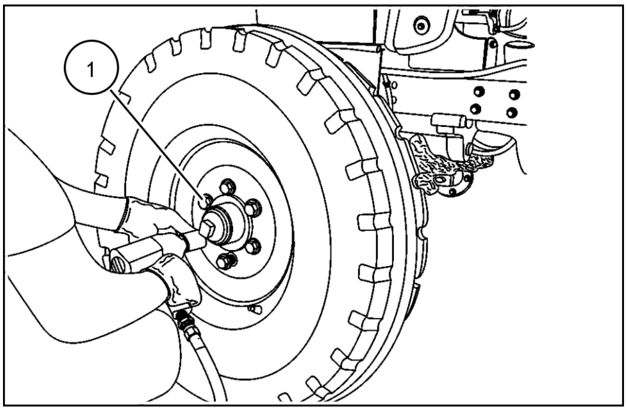
Swivel pins can be removed and overhauled with the front axle on the tractor. Proceed as follows for each wheel:

1. Safely block rear wheels.
2. Use a floor jack to raise the front of the tractor and place a jack stand, **(1)**, under the tractor.



20097801 1

3. Loosen retaining bolts, **(1)** and remove front wheels.

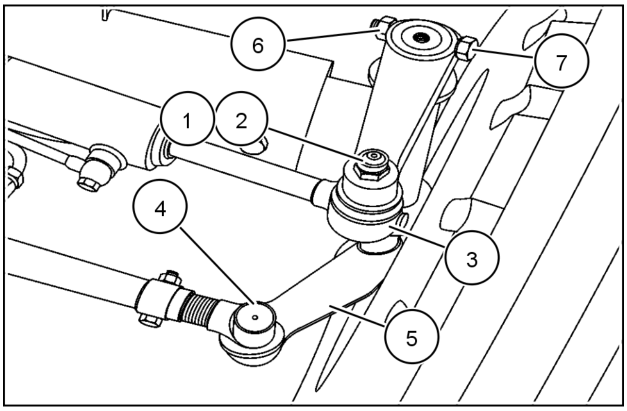


20099931 2

4. Remove the nut, **(1)**, and belleville washer, **(2)**, securing the cylinder rod ball joint, **(3)**, to power steering lever and separate the joint.
5. Remove the locknut, from the tie rod end, **(4)**.
6. Remove the tie rod end from the lever, **(5)**, on the spindle.

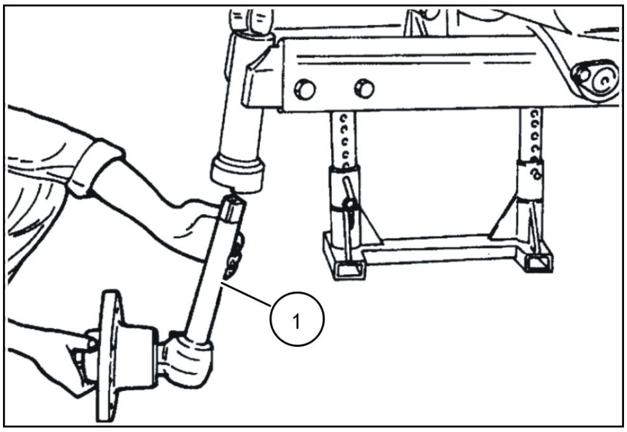
NOTE: *Only right-hand side of the front axle has the steering cylinder.*

7. Remove the nut and lockwasher, **(6)**, from the bolt, **(7)**, securing the power steering lever and spindle holder to the spindles.
8. Remove the bolt from the power steering lever and spindle holder.
9. Remove the power steering lever and spindle holder from the spindles.



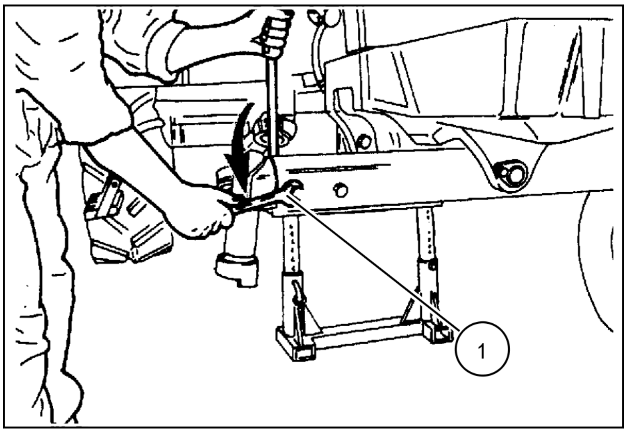
20099965 3

10. Pull out the spindle and hub assembly, **(1)**, from axle outer section.



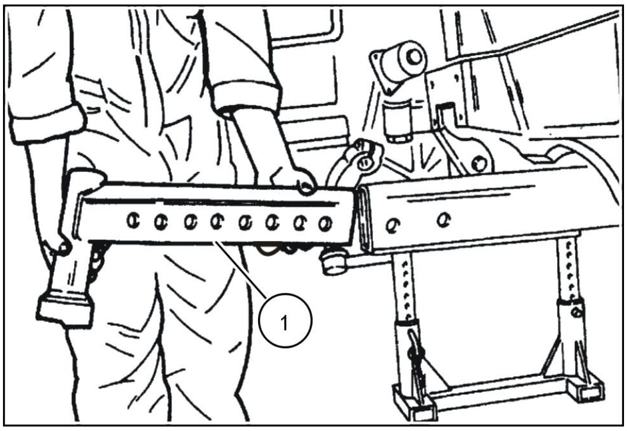
20096274 4

11. Remove the axle outer section, **(1)**, attaching bolts.



20096275 5

12. Remove the axle outer section, **(1)**.



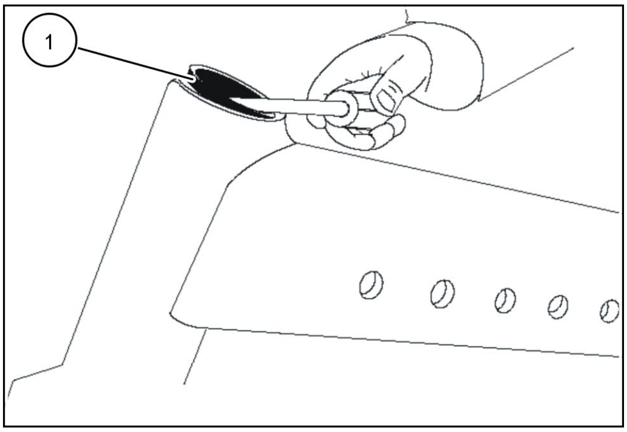
20096276 6

Next operation:
Spindle drive - Overhaul - 2WD (D.10.A)

Spindle drive - Overhaul - 2WD

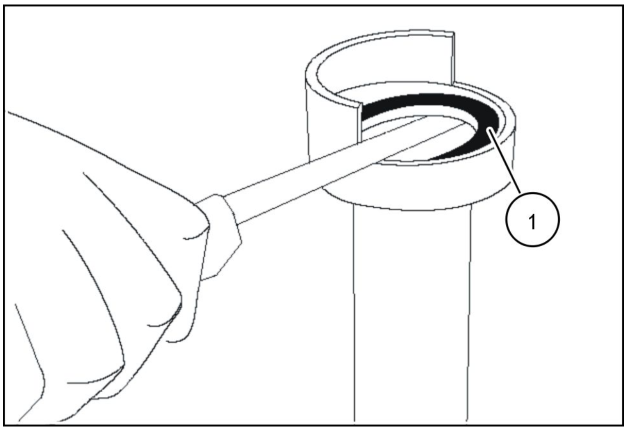
Prior operation:
Spindle drive - Remove - 2WD (D.10.A)

1. Place the axle outer section in a vice and remove the upper seal, **(1)**, using suitable tool.



20096277 1

2. Remove the bottom seal **(1)** using suitable tool and recover thrust washer.
3. Check the swivel bearing bushings for wear. See specifications section. If bushings require replacement, remove the bushings using suitable tool.
4. Using a suitable drift install new bushings on the axle outer section.
5. Check the swivel pin for wear. If required replace new spindle.
6. Ream the new bushings to suit the swivel pin.



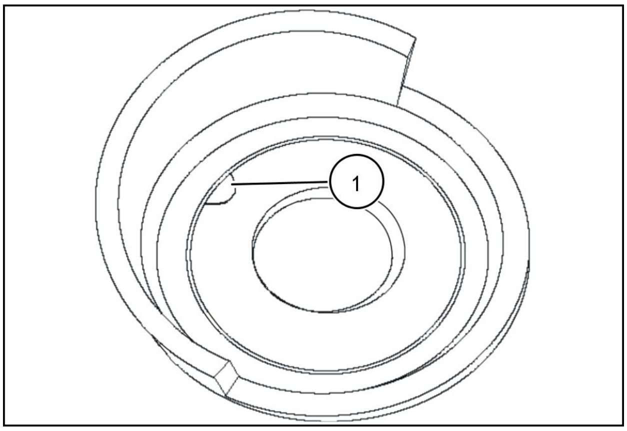
20096278 2

Next operation:
Spindle drive - Install - 2WD (D.10.A)

Spindle drive - Install - 2WD

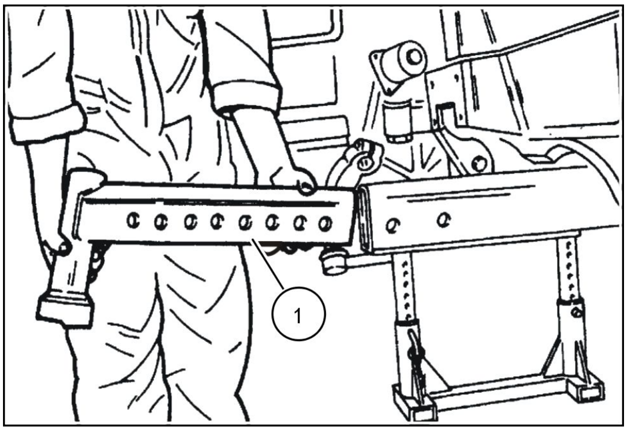
Prior operation:
Spindle drive - Overhaul - 2WD (D.10.A)

NOTE: *Ensure that the slot,* ***(1)****, in the thrust washer fits on the notch provided on the axle outer section.*



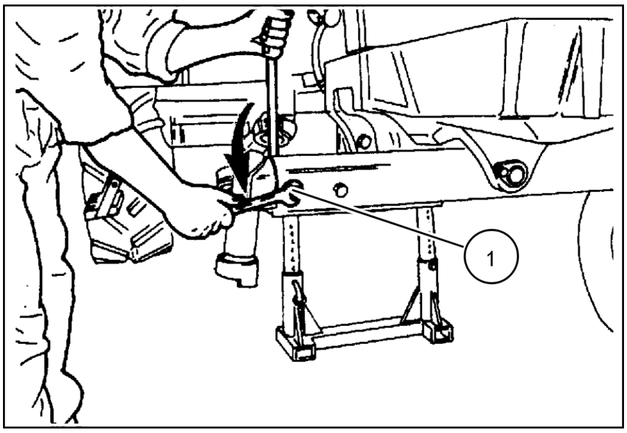
20096279 1

1. Slide the outer axle section, **(1)**, into the center axle housing.



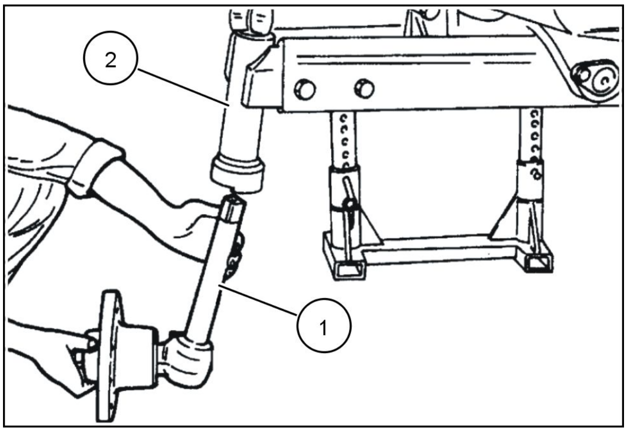
20096276 2

2. Install attaching bolts, **(1)**, that secure the outer axle section to the center axle housing.



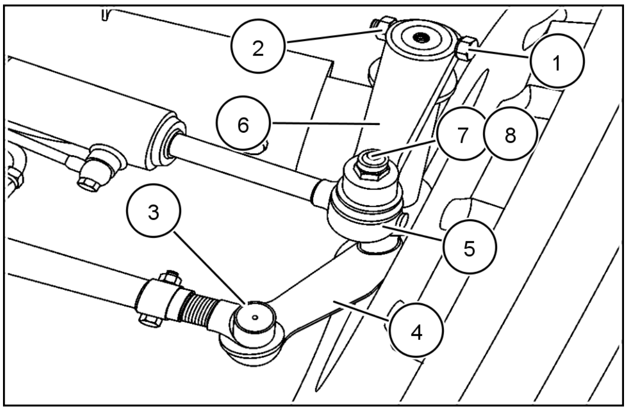
20096275 3

3. Slide the spindle and hub assembly, **(1)**, into the outer axle section, **(2)**.

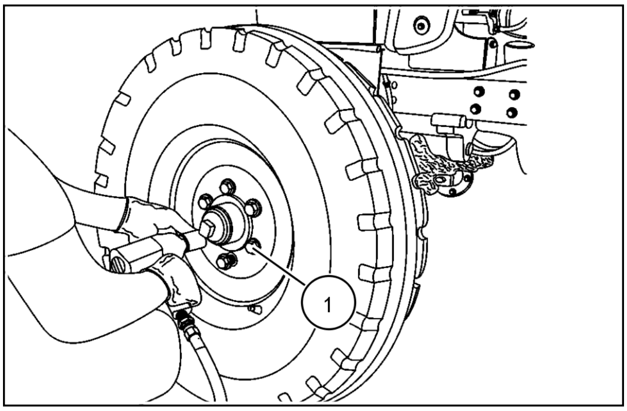


20096274 4

4. Secure the right-hand spindle with the power steering lever. Secure the lever with the bolt, **(1)**, lockwasher and nut, **(2)**.
5. Secure the left-hand spindle with the spindle holder. Secure the holder with the bolt, lockwasher and nut.
6. Connect the tie rod end, **(3)**, to the control lever, **(4)**, on the spindle.
7. Secure the tie rod end with the locknut.
8. Connect the steering cylinder rod ball joint, **(5)**, to the power steering lever, **(6)**.
9. Secure the ball joint using the belleville washer, **(7)**, and nut, **(8)**.
10. Reinstall the front wheels and torque the hardware to **333 N·m** (**246 lb ft**) ± **19 N·m** (**14 lb ft**).
11. Remove jack and/or stands from underneath the tractor.



20099965 5



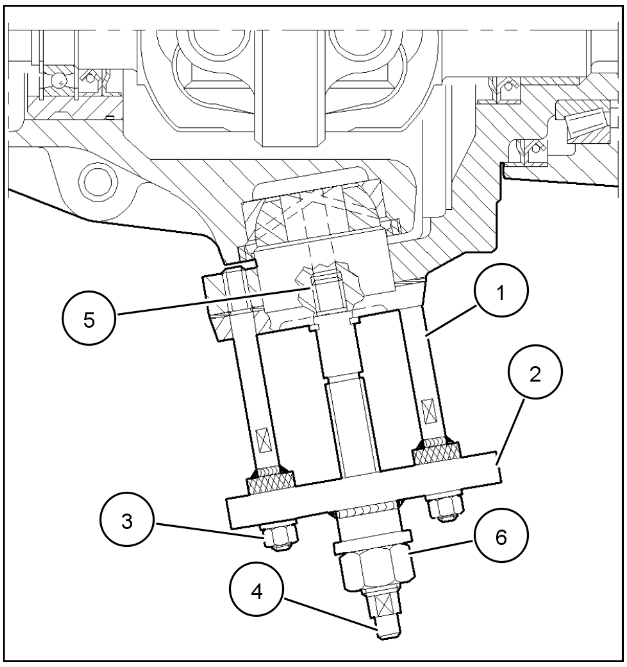
20099931 6

Steering knuckle and King pin - Replace - 4WD Steering knuckle pins and bearings

Prior operation:
FRONT AXLE - Remove - 4WD (D.10.A)

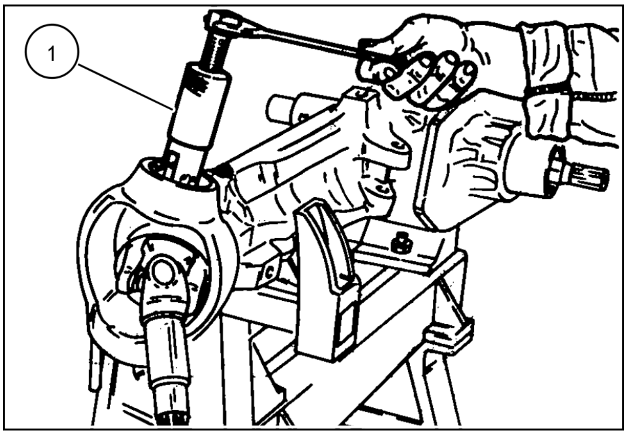
In the event that the steering knuckle pins prove difficult to remove, proceed as follows.

1. Remove the grease nipples and the steering knuckle pin retaining bolts.
2. Install the bolts, **(1)**, from tool number **380000265**.
3. Install the plate, **(2)**, from the tool and retain it to the three bolts with nuts, **(3)**.
4. Install the central tie bolt, **(4)**, screwing it fully into the grease nipple bore on the pin, **(5)**.
5. Screw in the nut, **(6)**, to drive the pin out of its bore.



20097690 1

6. Using extractor tool, tool number **380000234**, **(1)**, remove the steering knuckle bearings.
7. Re-install the steering knuckle bearings using a suitable drift.



20097691 2

Next operation:
Axle - Adjust - Stub axle adjustment 4WD (D.10.A)

Hub - Remove - 2WD

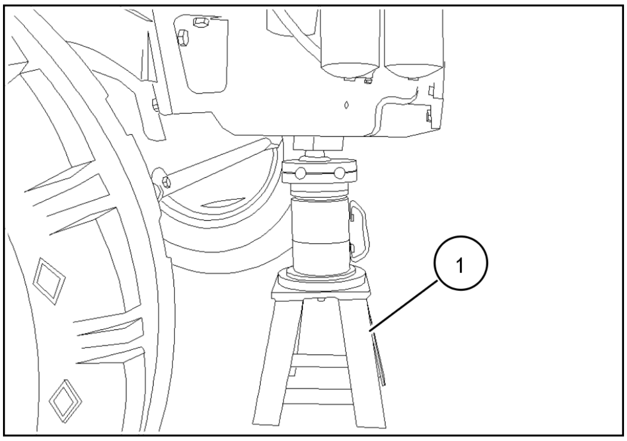
⚠ WARNING ⚠

Handle all parts carefully. Do not put your hands or fingers between parts. Always wear suitable safety items such as fitted clothing, safety goggles, gloves, shoes, etc. Failure to comply could result in death or serious injury.

M954A

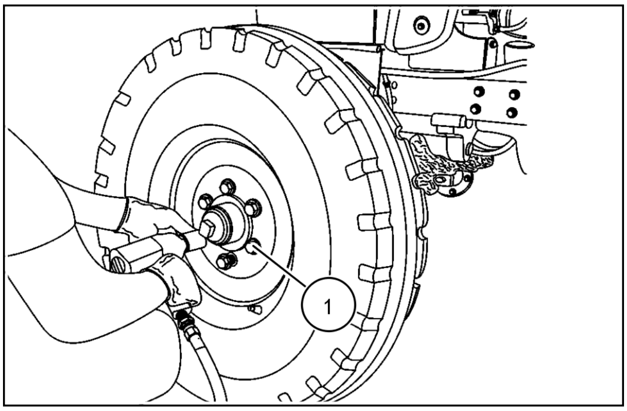
Wheel hubs can be removed with the front axle on the tractor. Proceed as follows for each hub:

1. Safely block rear wheels.
2. Use a floor jack to raise the front of the tractor and place a stationary stand, **(1)**, under the sump.



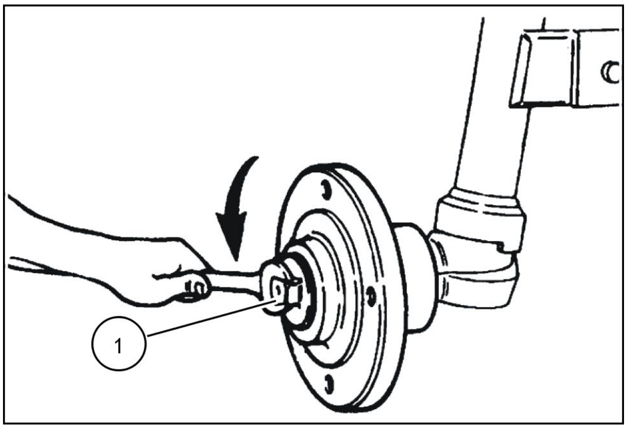
20097801 1

3. Loosen retaining bolts, **(1)**,and remove front wheels.



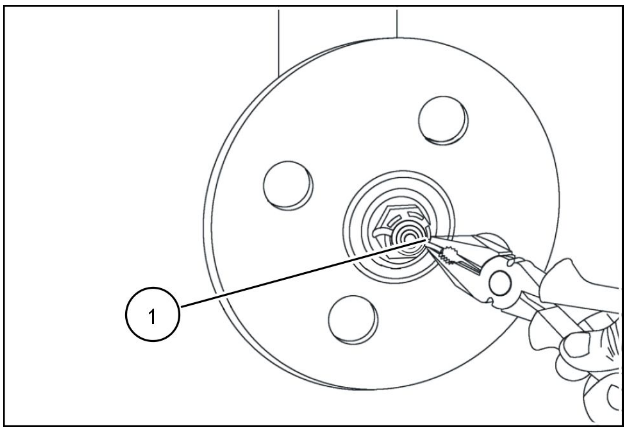
20099931 2

4. Remove wheel hub bearing grease cup, **(1)**.



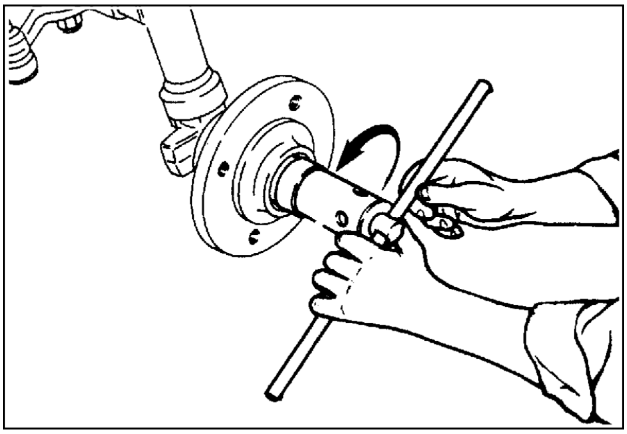
20096266 3

5. Remove the cotter pin, **(1)**.



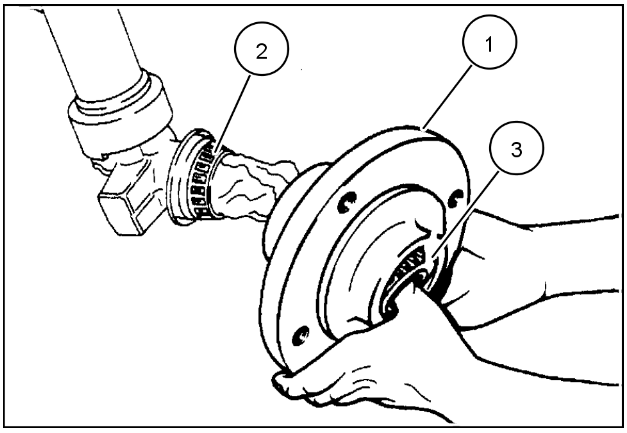
20096267 4

6. Using the socket spanner loosen the wheel hub bearing. Remove castle nut.



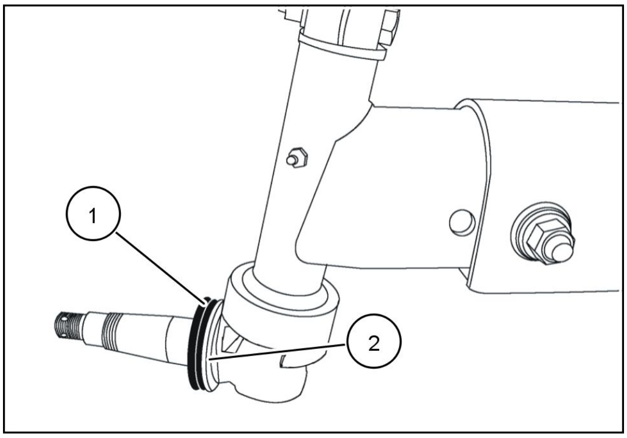
20096268 5

7. Remove wheel hub, **(1)**, and recover bearing, **(2)**, and **(3)**.



20096269 6

8. Remove seal, **(1)**, and nyloc ring, **(2)**, using suitable tool.



20096270 7

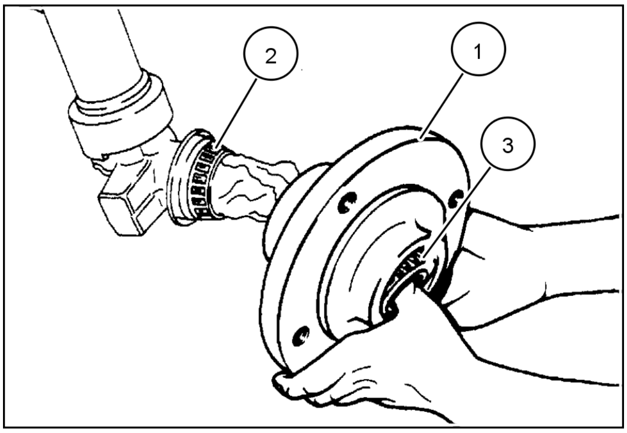
Next operation:
Hub - Install - 2WD (D.10.A)

Hub - Install - 2WD

Prior operation:
Hub - Remove - 2WD (D.10.A)

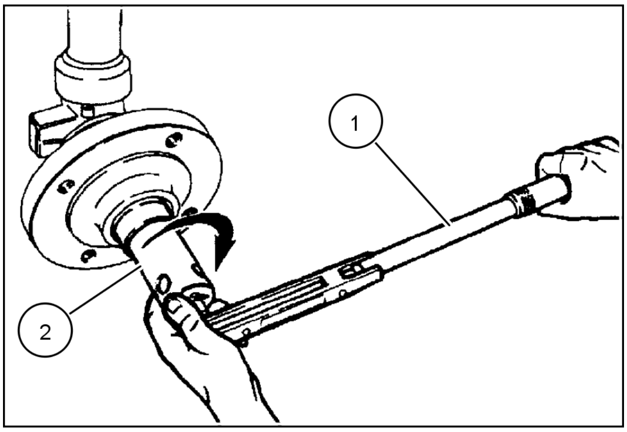
1. Replace faulty seals and worn bearing using suitable pullers and drifts.
2. Fill the wheel hub with specified grease.
3. Re-assemble the wheel hub, **(1)**, complete with the bearings, **(2)**, and **(3)**.

NOTE: *Picture for reference only.*



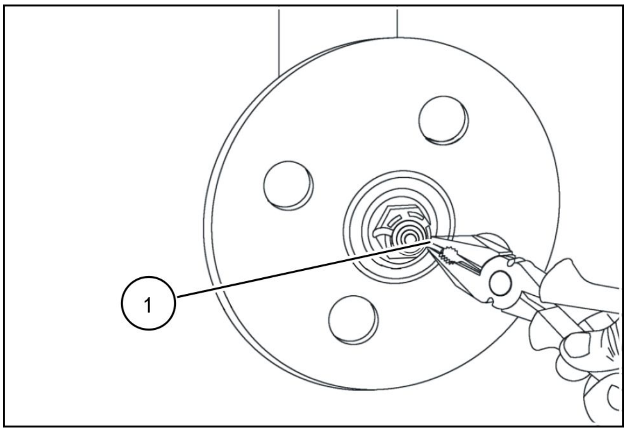
20096269 1

4. Using a torque wrench, **(1)**, and socket spanner, **(2)**, tighten the castle nut while turning the wheel hub, to settle the bearing. Tighten the nut until wheel hub gets slightly tight to rotate.
5. Loosen the castle nut and torque it again to **9.8 N·m** (**7.2 lb ft**) continuing to turn the wheel hub.



20096271 2

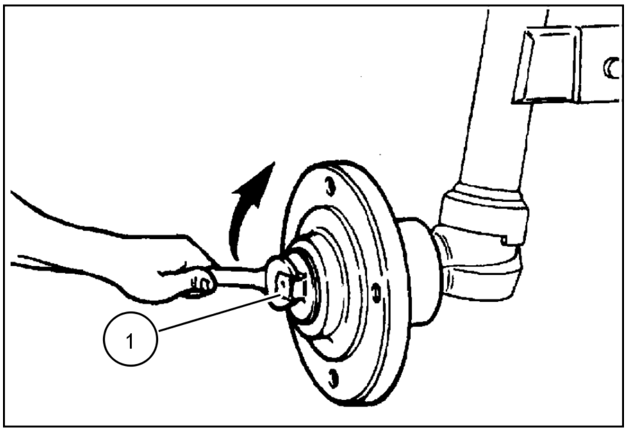
6. Insert a new cotter pin, **(1)**.



20096267 3

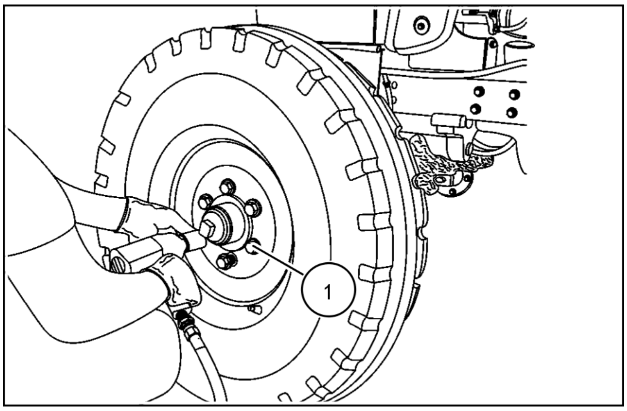
7. Reassemble the wheel hub dust cap, **(1)**.

NOTE: *Check the O-ring provided on the dust cap for any cut or damage. If required replace the O-ring.*



20096272 4

8. Reinstall the front wheels and torque the hardware to **333 N·m** (**246 lb ft**) ± **19 N·m** (**14 lb ft**)
9. Remove jack and/or stands from underneath the tractor.

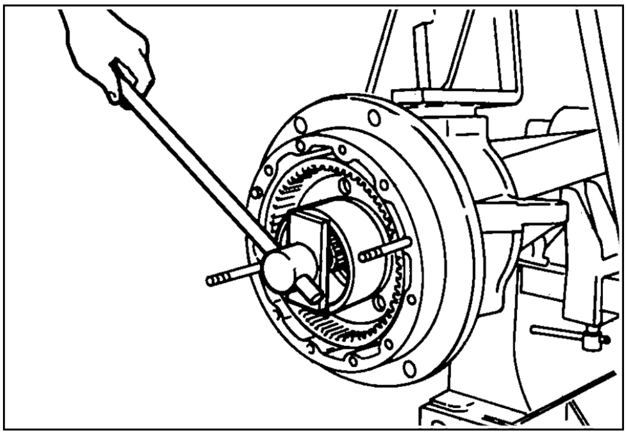


20099931 5

Hub - Adjust Wheel hub bearing adjustment 4WD

Prior operation:
FRONT AXLE - Remove - 4WD (D.10.A)

1. Proceed as follows:
   - Install wheel hub and fixed gear unit onto the steering knuckle.
   - Using a torque wrench and lock ring wrench, tool number **380000295**, progressively tighten the lock ring to **147 - 196 N·m** (**108 - 145 lb ft**). While tightening the lock ring, rotate the hub to seat the bearings.
   - Fully loosen the lock ring and retighten to **392 N·m** (**289 lb ft**) while rotating hub.
   - Secure the lock ring by bending over a lock washer tab (if necessary, further tighten the lock ring to align a slot with the tab).
   - Turn the hub by hand to check for excessive play or binding.



20097696 1

Next operation:
Differential - Adjust - 4WD Bevel drive adjustment (D.10.A)

FRONT AXLE - Troubleshooting 2WD

Problem	Possible Cause	Correction
Premature tire wear	Wrong inflation pressure.	Inflate tires to correct pressure refer to values suggested in the Operator’s Manual. Always comply with values specified by the tire manufacturer.
	Wrong front wheel toe-in.	Adjust toe-in (refer the procedure explained in **FRONT AXLE - Adjust (D.10.A)**under adjustment).
Poor tractor stability	Wrong inflation pressure.	Inflate tires to correct pressure.

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Workmaster 45
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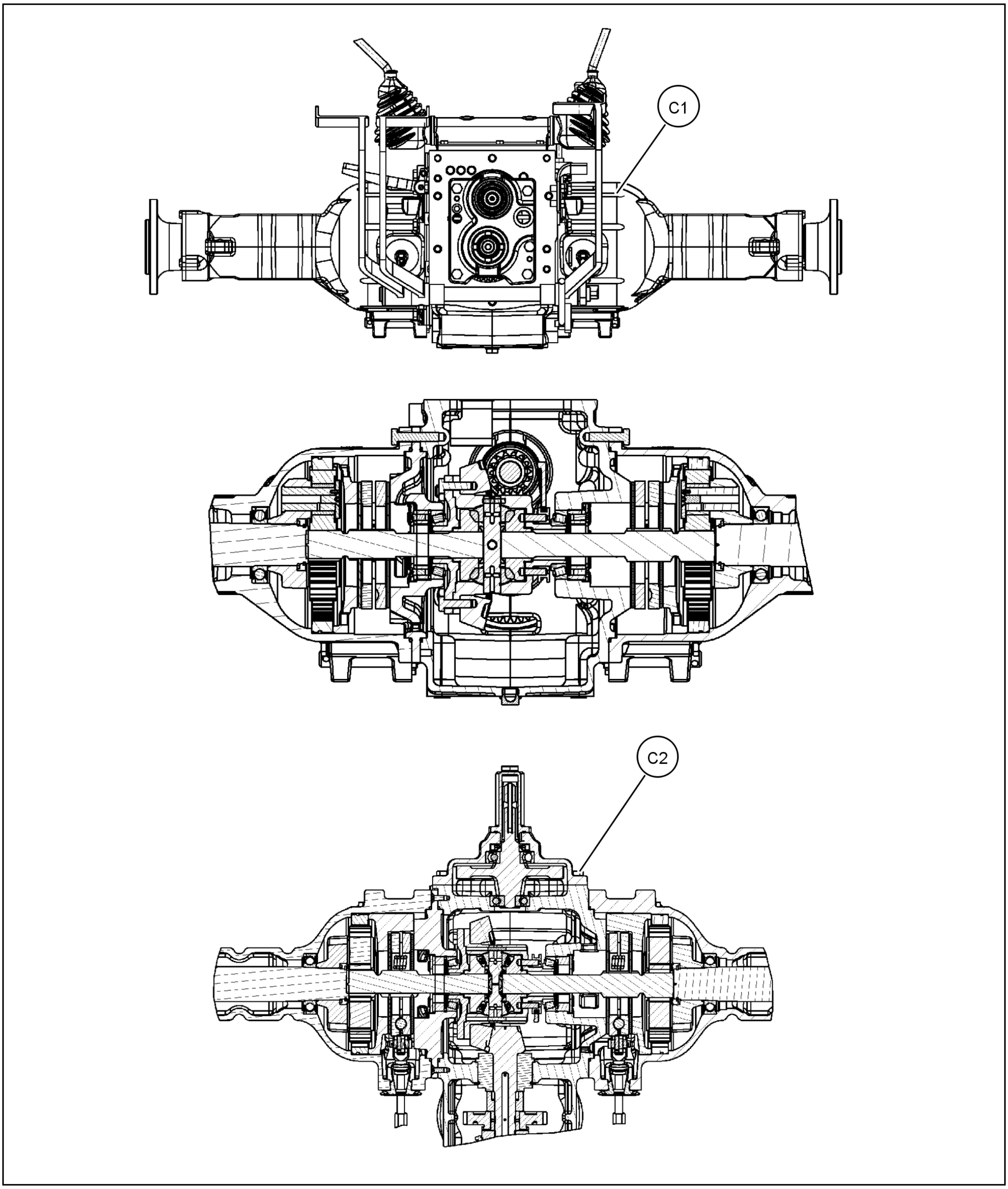
REAR AXLE - General specification

PINION TO RING GEAR AND DIFFERENTIAL

Pinion and ring gear ratio Pinion to ring gear backlash Differential Differential lock control type	 **0.18 mm** (**0.007 in**) - **0.23 mm** (**0.009 in**) 4 pin Mechanical operated with foot pedal
Differential lock free spring length Compressed spring length, under a load of 36.5 kg/mm2	**106 mm** (**4.17 in**) **82 mm** (**3.23 in**)
Side gear to differential gear backlash Differential gear pin diameter Bore diameter on differential gears for pin Bore diameter on differential case for pin Pin to differential gear clearance Pin to differential case clearance	**0.1 mm** (**0.004 in**) - **0.25 mm** (**0.010 in**) **21.96 mm** (**0.865 in**) - **21.939 mm** (**0.864 in**) **22.098 mm** (**0.870 in**) - **22.065 mm** (**0.869 in**) **22.02 mm** (**0.867 in**) - **22 mm** (**0.866 in**) **0.159 mm** (**0.006 in**) - **0.04 mm** (**0.002 in**) **0.082 mm** (**0.003 in**) - **0.04 mm** (**0.002 in**)

REAR AXLE - Torque

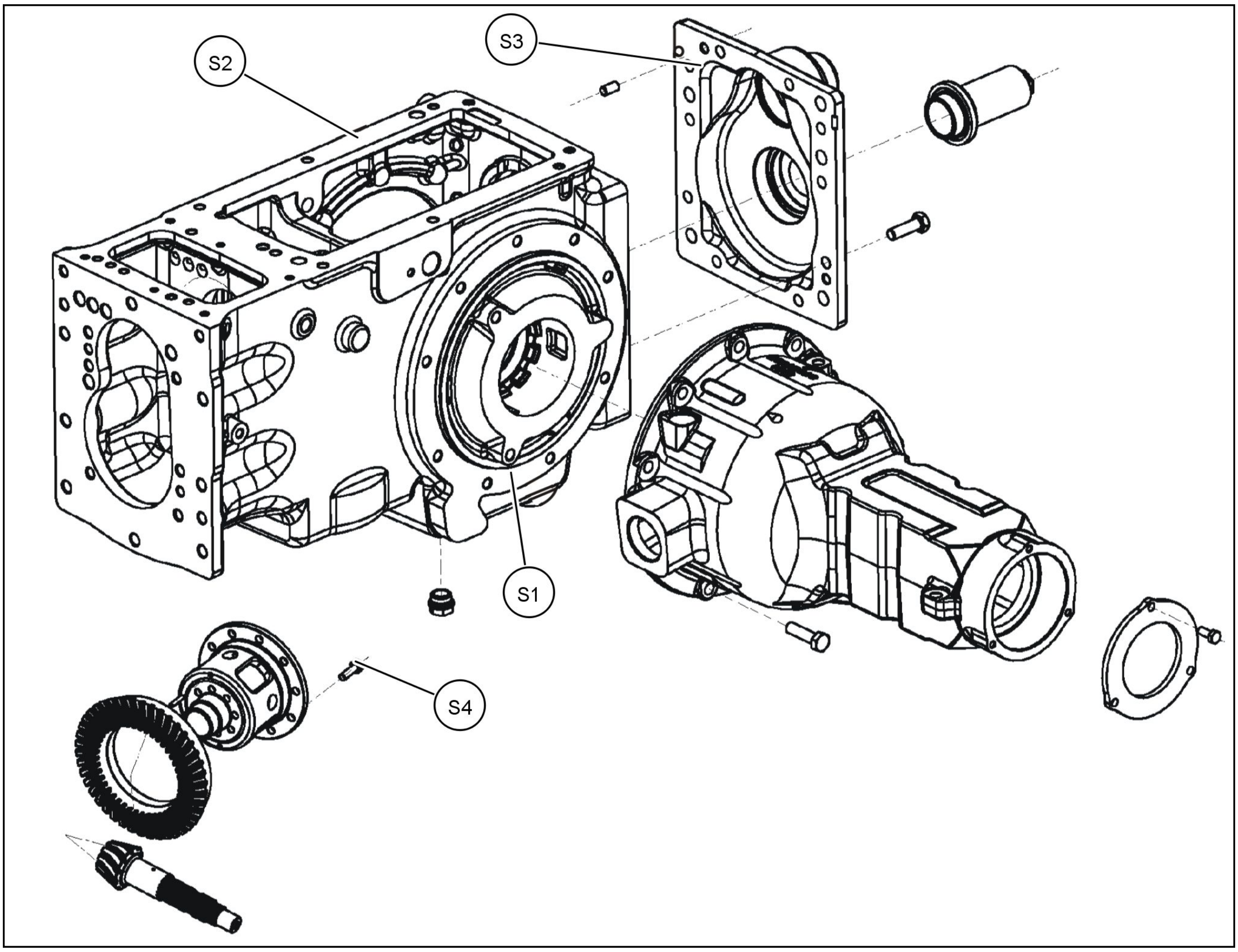
Description	Thread Size (mm)	Torque N.m (lb ft)
Rear axle to Transmission housing attaching bolts **(C1)**	M12x1.25	**98 N·m** (**72 lb ft**)
PTO cover bolts **(C2)**	M12	**98 N·m** (**72 lb ft**)
Ring Gear bolts **(C3*)**	M10	**59 N·m** (**44 lb ft**)
Drain plug **(C4)**	M22	**44 N·m** (**32 lb ft**)



20098347 1

REAR AXLE - Sealing

Operation Description	Sealant Specification
Rear axle to transmission housing **(S1)**	**LOCTITE® 518**
Lift housing to transmission housing **(S2)**	**LOCTITE® 518**
PTO cover plate **(S3)**	**LOCTITE® 518**
Ring gear bolts **(S4)**	**LOCTITE® 243**.



20098345 1

REAR AXLE - Special tools

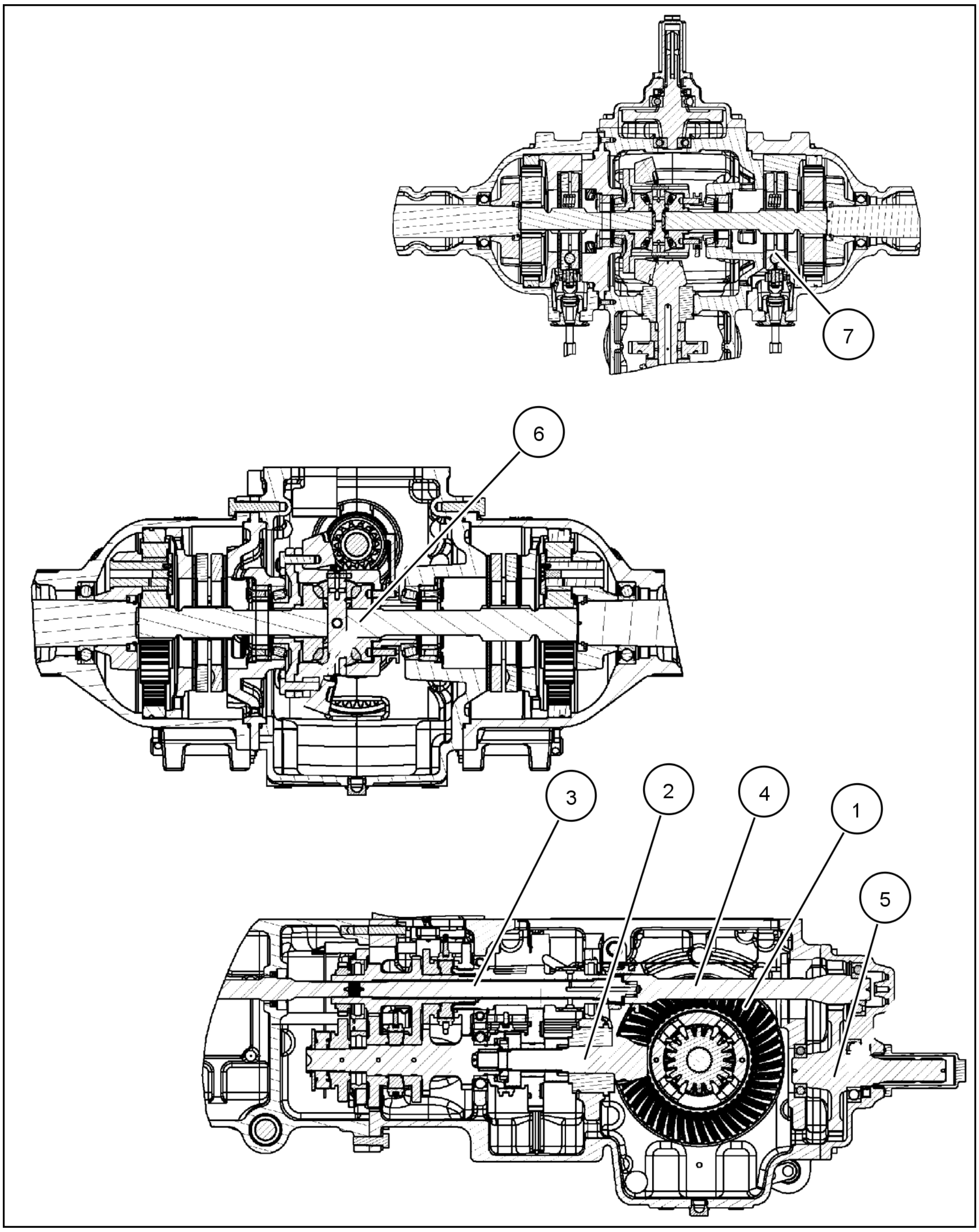
Tool Description	Tool No.
Differential plate check nut tightening tool	**380002988**
Installer oil seal wheel side (Heavy duty)	**380002980**
Socket allen key 6 mm	Procure locally
Yoke and Spreader	Use suitable tool procured locally

Final drive - General specification

Type	Epicyclic
Reduction ratio	**6.55 mm** (**0.258 in**)

REAR AXLE - Sectional view

RING GEAR AND DIFFERENTIAL ASSEMBLY.



20098348 1

1.	Ring gear	5.	PTO shaft
2.	Pinion shaft	6.	Differential assembly
3.	Input shaft	7.	Brake
4.	PTO Input shaft		

REAR AXLE - Static description

The rear axle assembly transfers drive from the transmission to the planetary gears through a bevel pinion and ring gear coupling. The bevel gears are spiral type and are supported by tapered roller bearings.

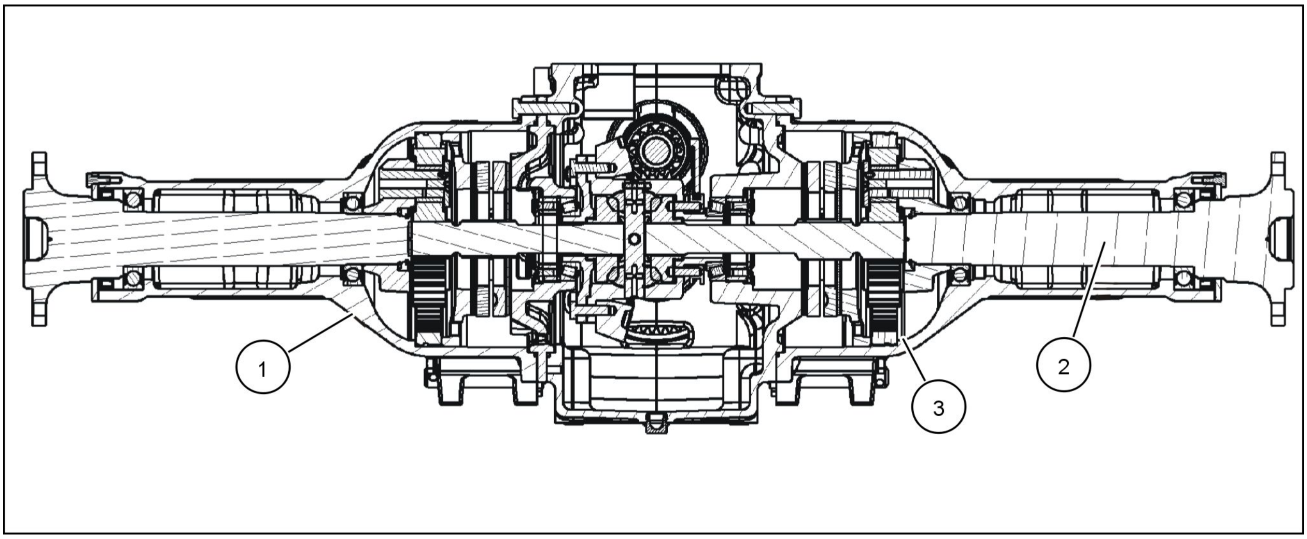
The differential is fitted with four planetary and two side gears and mechanical lock. The differential lock is dog clutch type and operated by foot pedal located below operator’s seat at right hand side.

The planetary reduction gear set is controlled by the bevel pinion and crown wheel output half -- shaft, which also controls the brakes.

Planetary helps in improving traction and increasing brakes life. It also gives more ground clearance and it is sealed against water and dust.

In this cascade arrangement half axle is fitted into two side gears which rotates the planetary gears through a ring gear, resulting into reduction of speed, that turn is transfered to rear axle.

Final drive - Sectional view



20098349 1

1. Trumpet housing
2. Rear wheel shaft
3. Planetary gear

REAR AXLE - Remove Housing - Left-hand side or right-hand side

⚠ WARNING ⚠

Handle all parts carefully. Do not put your hands or fingers between parts. Always wear suitable safety items such as fitted clothing, safety goggles, gloves, shoes, etc. Failure to comply could result in death or serious injury.

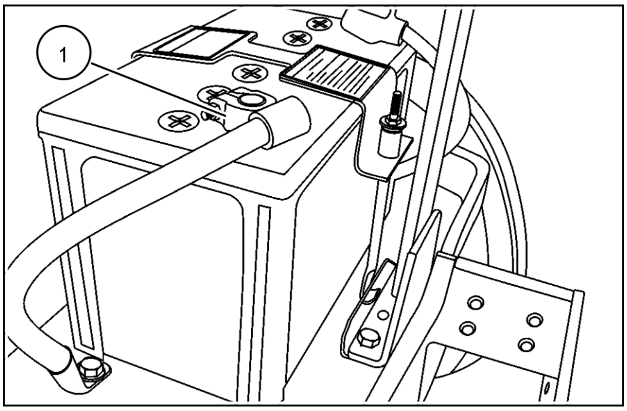
M954A

⚠ DANGER ⚠

Lift and handle all heavy components using lifting equipment of appropriate lifting capacity. Make sure that units or parts are supported by suitable slings or hooks. Make sure that no-one is in the vicinity of the load to be lifted. Failure to comply could result in serious injury or death.

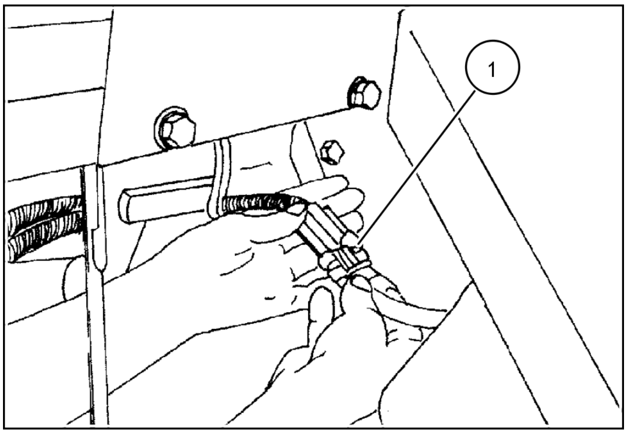
B012

1. Disconnect the negative battery cable from the negative battery terminal, **(1)**.



20099930 1

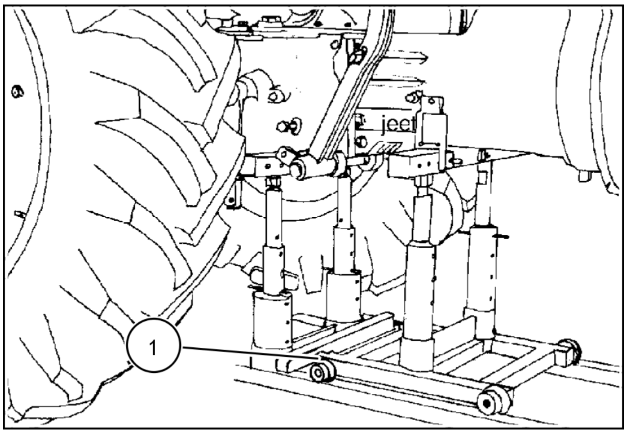
2. Disconnect the electrical connections, **(1)**, between left-hand side and right-hand side fenders.



20096205 2

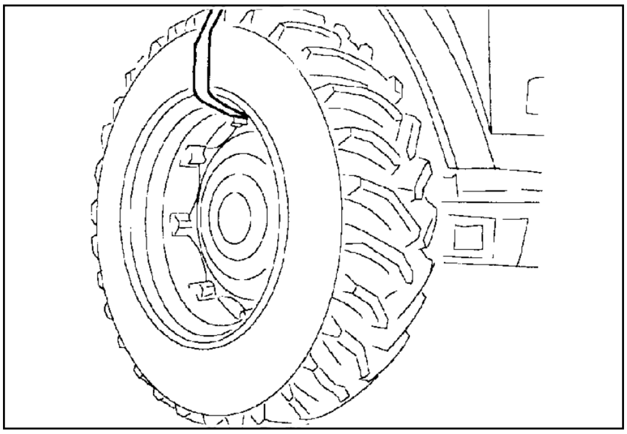
3. Use a floor jack to raise the rear of the tractor and place suitable jack stands or splitting trolley, **(1)**, under the rear of the tractor.

NOTE: *Place suitable blocks in front and behind the front wheels.*



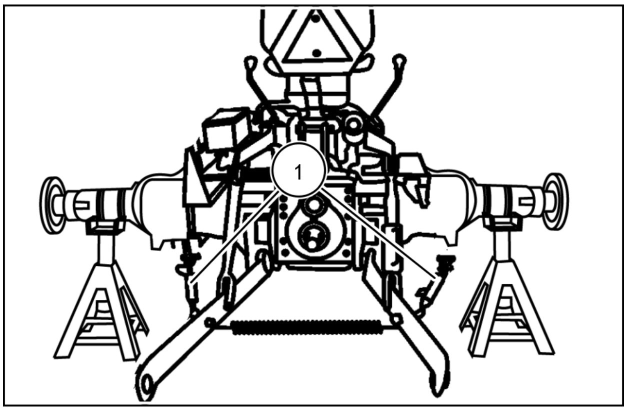
20096209 3

4. Remove both left-hand side and right-hand side wheels.
5. Drain the oil from the combined transmission / differential and rear axle housings into a suitable container.



20096210 4

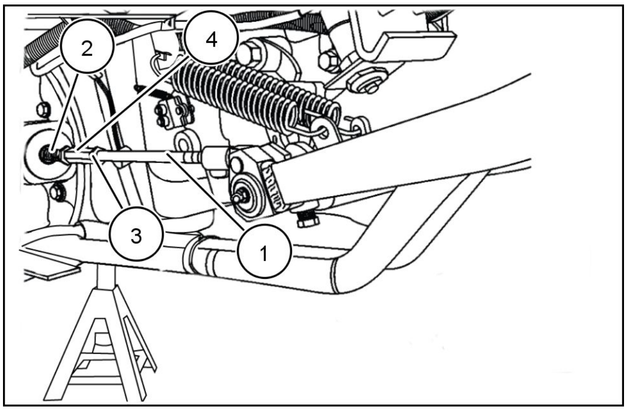
6. Remove the lower lift links, **(1)**, from the rear axles.



20102976 5

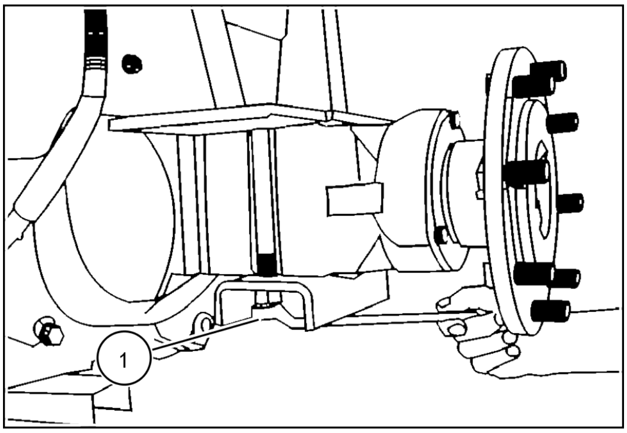
7. Disconnect the front brake rod, **(1)**, from the rear brake rod, **(2)**, by loosening the M12 jam nut, **(3)**. Turn the turn buckle, **(4)**, until it is removed from the front brake rod.

NOTE: *The brake rods have left-handed threads.*



20102977 6

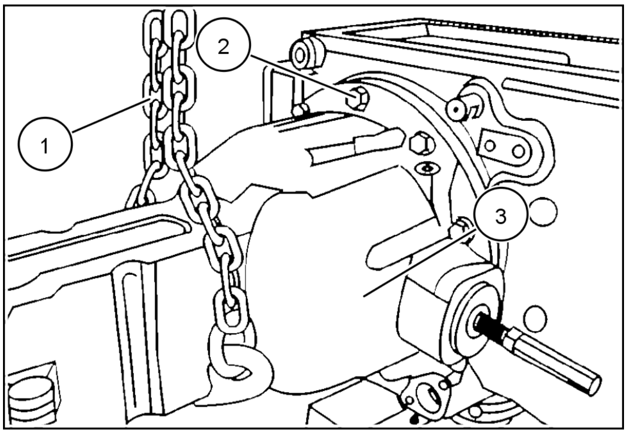
8. Remove the bolts, **(1)**, securing the ROPS and fenders on both the left-hand side and right-hand side.



20097821 7

9. Wrap a suitable chain or nylon strap, **(1)**, around the rear axle housing and connect it to a hoist.
   Remove M12 retaining bolts, **(2)**.
10. Separate the rear axle housing, **(3)**, from the transmission / differential housing and place it on a flat surface.

NOTE: *The left-hand side and right-hand side rear axles are not identical. Each axle has a stamp on the top which identifies which side the axle goes on.*



20097830 8

Next operation:
REAR AXLE - Disassemble Housing - Left-hand side or right-hand side (D.12.A)

REAR AXLE - Disassemble Housing - Left-hand side or right-hand side

Prior operation:
. REAR AXLE - Remove Housing - Left-hand side or right-hand side (D.12.A)

⚠ WARNING ⚠

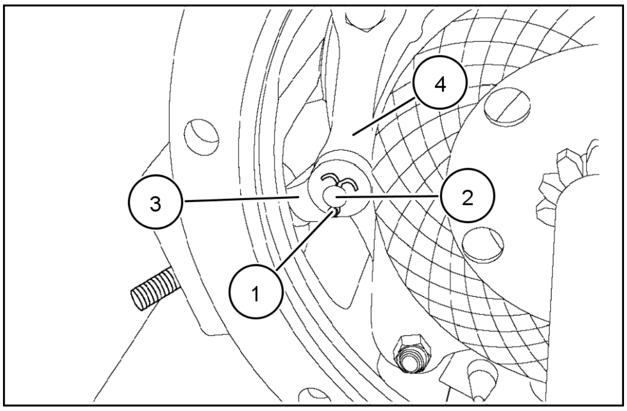
Handle all parts carefully. Do not put your hands or fingers between parts. Always wear suitable safety items such as fitted clothing, safety goggles, gloves, shoes, etc. Failure to comply could result in death or serious injury.

M954A

1. Remove the cotter pin, **(1)**, and brake rod linkage pin, **(2)**, from the rear brake rod, **(3)**, and brake actuator, **(4)**.

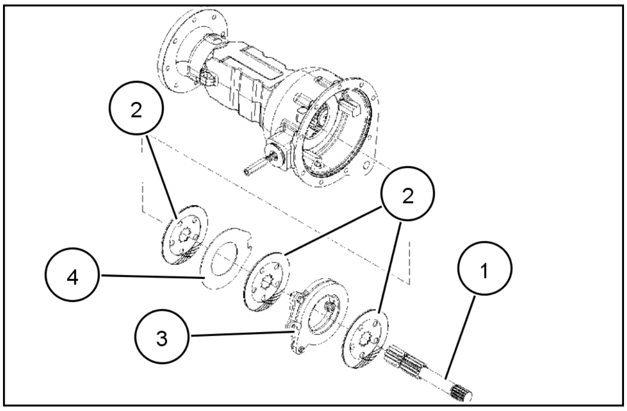
NOTE: *In order to remove the brake rod linkage pin, slide the brake actuator out until the pin can be removed.*

NOTE: *Push the rear brake rod out towards the front of the axle housing.*



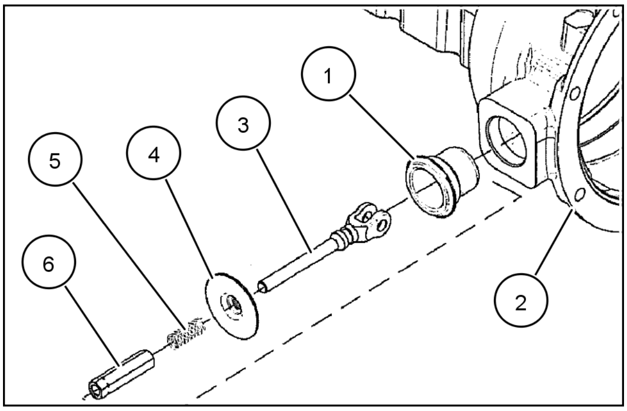
33083225 1

2. Pull out the differential shaft, **(1)**, along with the brake discs, **(2)**, brake actuator, **(3)**, and stator, **(4)**, from the axle housing, **(5)**.



33083226 2

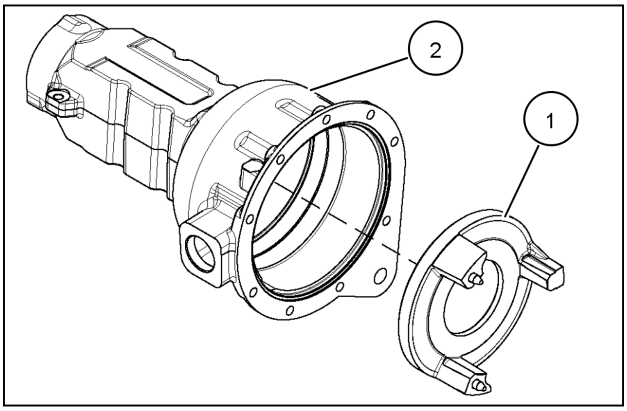
3. Remove the brake rod rubber bellow, **(1)**, from the axle housing, **(2)**.
4. Remove the rear brake rod, **(3)**, through the anti-dust seal, **(1)**, and then remove the dust cover, **(4)**, from the brake rod, **(3)**.
5. Remove the spring, **(5)**, from the rear brake rod, **(3)**.
6. Unscrew the tie rod, **(6)**, from the end of the brake rod, **(3)**.



20099979 3

7. Remove the brake disc support, **(1)**, from the axle housing, **(2)**.

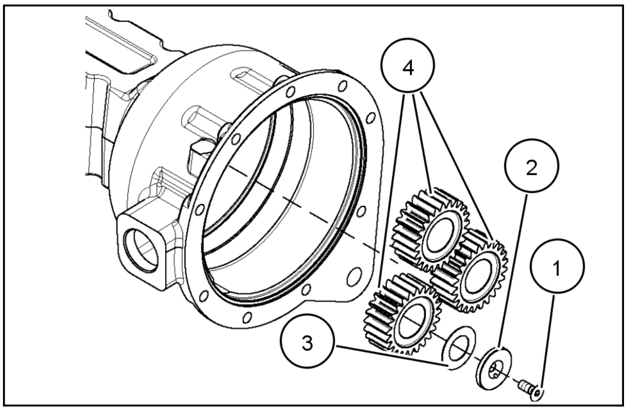
NOTE: *The WORKMASTER 45 tractor uses a low duty brake disc support and the WORKMASTER 55 uses a heavy duty brake disc support.*



33084220 4

8. Remove the M10 x 25 counter socket screws, **(1)**, spacers, **(2)**, and thrust washers, **(3)**, from the planetary gears, **(4)**.

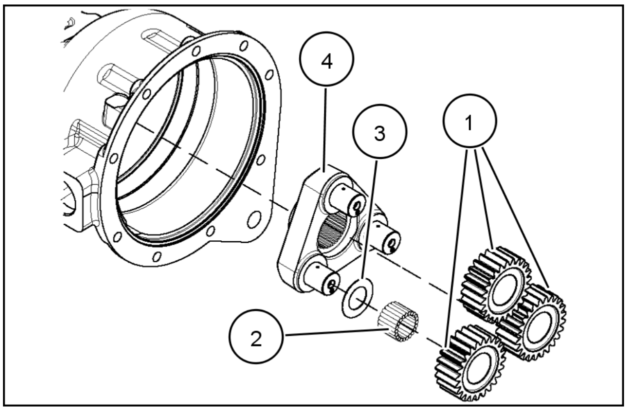
NOTICE: *Before removing the screws from the planetary gears heat the screws with a suitable heat source. Use an impact driver to remove the screws.*



33084221 5

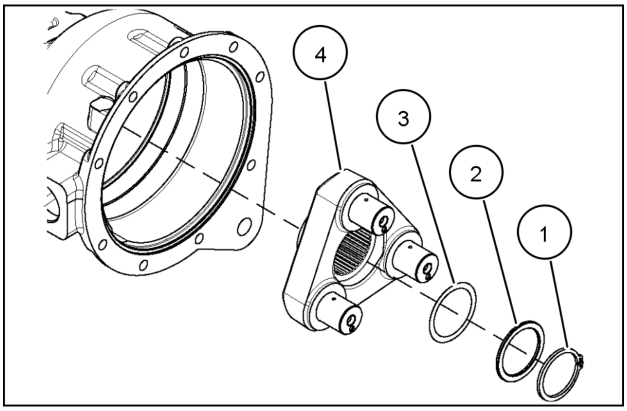
9. Remove the planetary gears, **(1)**, loose needle bearings, **(2)**, and thrust washers, **(3)**, from the planetary gear carrier, **(4)**.

NOTE: *When removing the planetary gears, take care not to lose any of the loose needle bearings.*



33084222 6

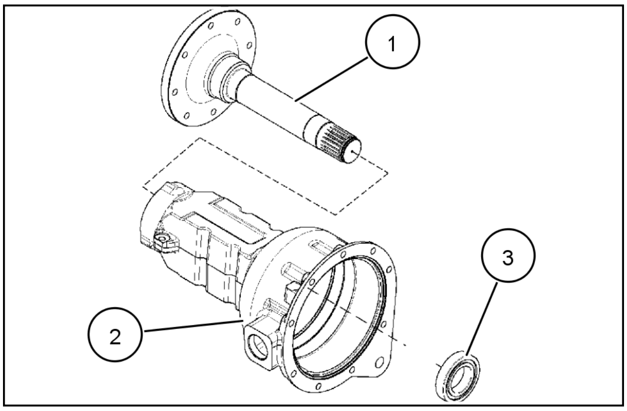
10. Remove the snap ring, **(1)**, spacer, **(2)**, and shim, **(3)**, from the axle shaft and remove the planetary gear carrier, **(4)**.



33084223 7

11. Remove the axle shaft, **(1)**, from the axle housing, **(2)**, using a hammer and aluminium drift.
12. Remove the inner ball bearing, **(3)**, from the axle housing, **(2)**, using a suitable puller and slide hammer.

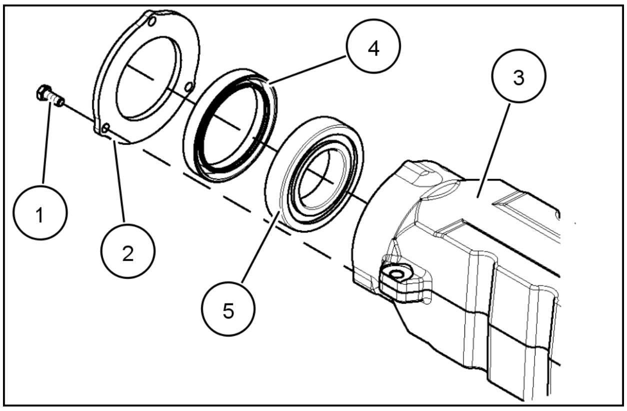
NOTE: *Tapered bearings are used on the WORKMASTER 55 tractor.*



93097057 8

13. Remove the M8 x 20 cap screws, **(1)**, and remove the cover, **(2)**, from the axle housing, **(3)**.
14. Remove the outer seal, **(4)**, from the axle housing, **(3)**, using a seal removal tool. Discard the outer seal once removed.
15. Remove the ball bearing, **(5)**, from the axle housing, **(3)**, using a suitable puller and slide hammer.

NOTE: *Tapered bearings are used on the WORKMASTER 55 tractor.*



20099912 9

Next operation:
REAR AXLE - Inspect (D.12.A)

REAR AXLE - Inspect

Prior operation:
REAR AXLE - Disassemble Housing - Left-hand side or right-hand side (D.12.A)

1. Clean the axle components with a suitable solvent and allow to air dry.
2. Rotate the bearings by hand to check for roughness or binding. Check the bearing for excessive wear or damage. Replace as necessary.
3. Inspect the teeth on the planetary gears for excess wear or damage. Replace as necessary.
4. Inspect the axle shafts for nicks, scratches or other damage. Repair or replace as necessary.
5. Inspect axle housing for cracks or other damage. Replace as necessary.

Next operation:
REAR AXLE - Assemble (D.12.A)

REAR AXLE - Assemble

Prior operation:
REAR AXLE - Inspect (D.12.A)

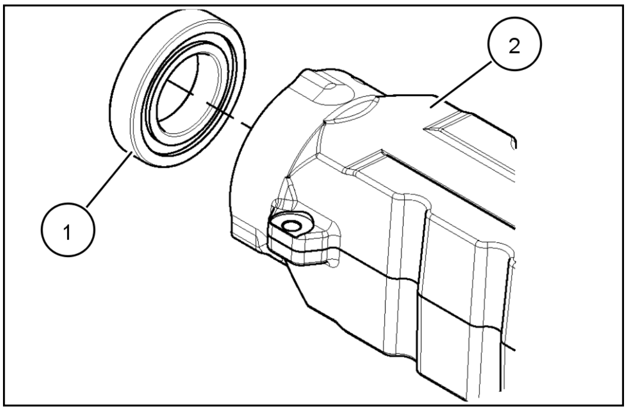
⚠ **WARNING** ⚠

Handle all parts carefully. Do not put your hands or fingers between parts. Always wear suitable safety items such as fitted clothing, safety goggles, gloves, shoes, etc. Failure to comply could result in death or serious injury.

M954A

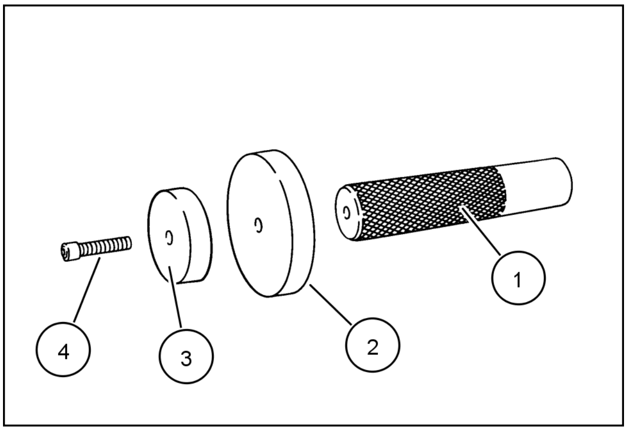
1. Install the outer bearing, **(1)**, into the axle housing, **(2)**, using a suitable driver.

NOTE: *Tapered bearings are used on the WORKMASTER 55 tractor.*



33084259 1

2. Assemble the special installation tool, from the seal installer kit **NH00293**. Use handle **(1)**, NH27488, drive plate, **(2)**, drive plate, **(3)**, and secure with the supplied retaining screw, **(4)**.



20002392A 2

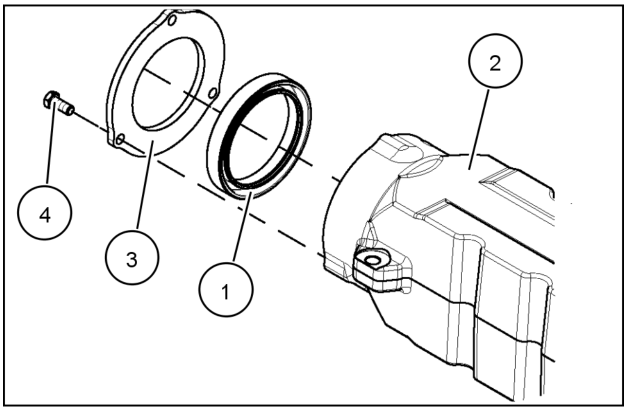
Axle Seal	Tool No.	Size
Inner	**(1)** Handle NH27488	
	(2) Plate NH27539	3-½ in.
	(3) Plate NH27531	3 in.
	(4) Screw	
Outer	**(1)** Handle NH27488	
	(2) Plate NH27539	3-11/16 in.
	(3) Plate NH27531	3-5/16 in.
	(4) Screw	

3. Install a new outer axle seal, **(1)**, into the axle housing, **(2)**, using the special seal driver tool.

NOTE: *The orientation of the outer axle seal,* ***(1)****, in the axle housing,* ***(2)****, is such that the rubber side of the seal faces inward and the metal side of the seal faces the outward away from the axle housing,* ***(2)****.*

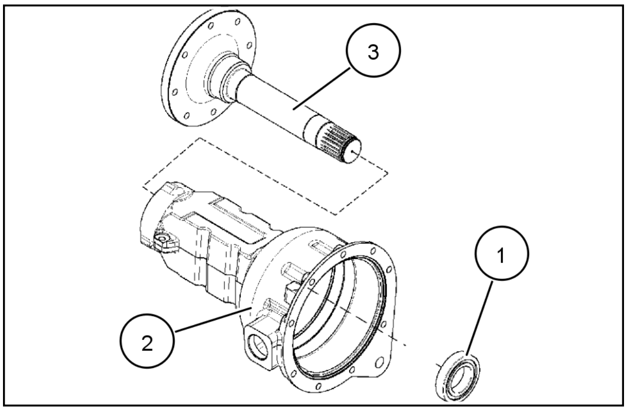
4. Install the cover, **(3)**, onto the axle housing, **(2)**, and secure using the three M8 x 20 cap screws, **(4)**. Torque the cap screws to **49 - 62.8 N·m** (**36.1 - 46.3 lb ft**).

NOTE: *Use* ***LOCTITE® 242*** *on the cover cap screws.*



33084260 3

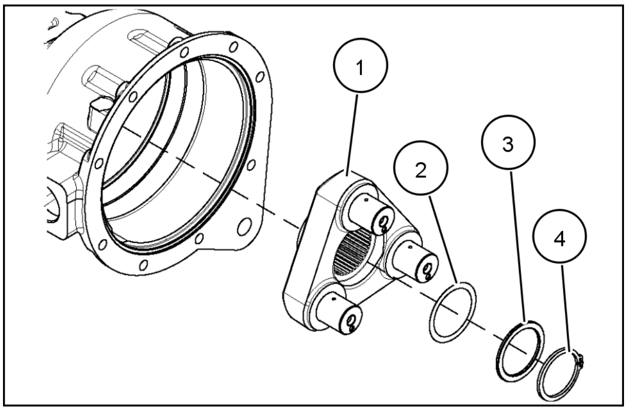
5. Install the inner bearing, **(1)**, into the axle housing, **(2)**, using a suitable driver.
6. Lubricate the new seals with petroleum jelly, and slide the axle shaft, **(3)**, into the axle housing, **(2)**.



93097057 4

7. Install the planetary gear carrier, **(1)**, shims, **(2)**, and spacer , **(3)**, onto the axle shaft and secure with the snap ring, **(4)**.

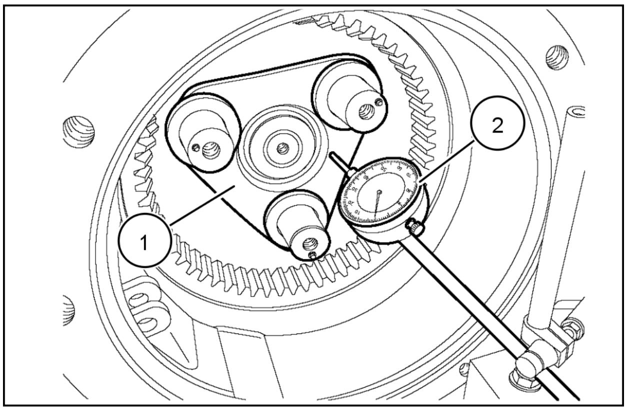
NOTE: *Shim sizes are* ***0.15 mm*** *(****0.006 in****).*



33084223 5

8. Measure the end play of the planetary gear carrier, **(1)**, by placing a dial indicator, **(2)**, against the planetary gear carrier as shown.
9. Set the dial indicator, **(2)**, to zero, and then slide the planetary gear carrier, **(1)**, back and forth on the axle shaft. The planetary gear carrier should have an end play of **0.05 - 0.7 mm** (**0.002 - 0.028 in**).

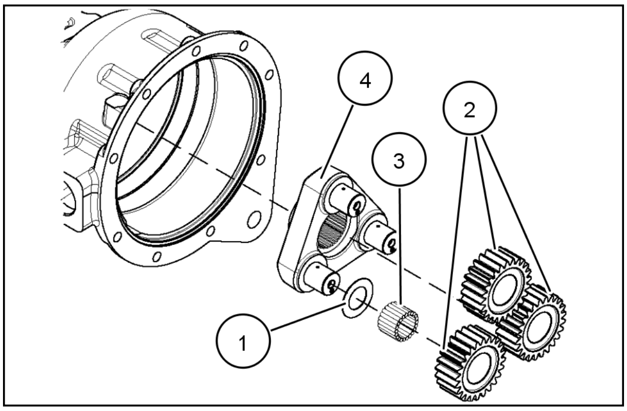
NOTE: *If the end play measurement is not correct the shims will need to be readjusted.*



83085847 6

10. Install the washers, **(1)**, planetary gears, **(2)**, and loose needle bearings, **(3)**, onto the planetary gear carrier, **(4)**.

NOTE: *To aid in assembly, apply petroleum jelly to the needle bearings.*

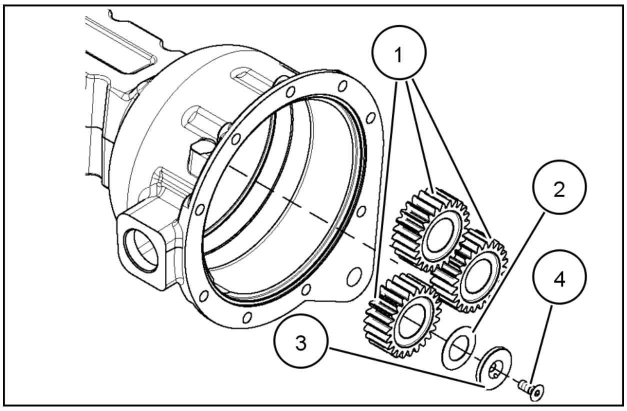


33084222 7

11. Secure the planetary gears, **(1)**, to the planetary gear carrier by installing the washers, **(2)**, spacers, **(3)**, and M10 x 25 countersunk socket screws, **(4)**. Torque the cap screws to **43 N·m** (**31.7 lb ft**).

NOTICE: *When installing the spacers onto the planetary gears, make sure the holes in the spacers are lined up with the pins on the carrier.*

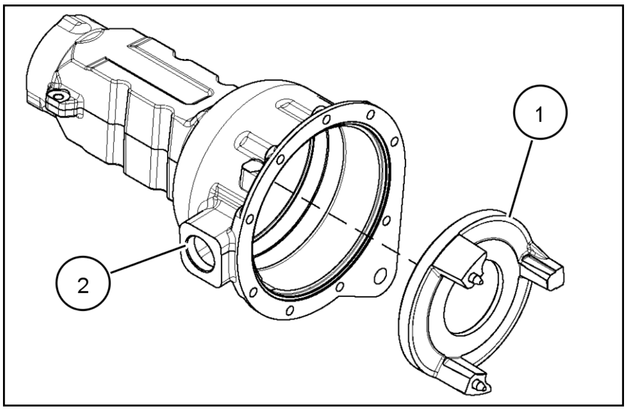
NOTE: *Use **LOCTITE® 242** on the cap screws.*



33084221 8

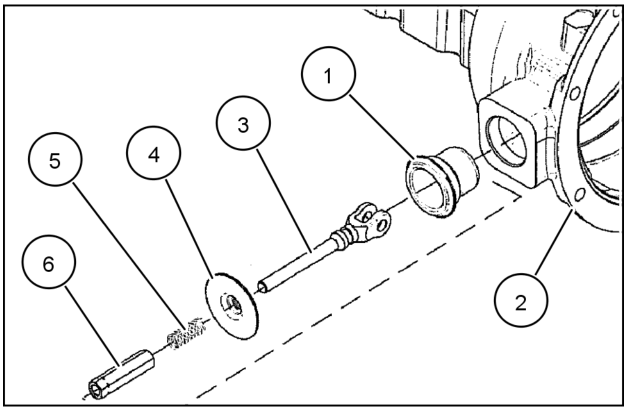
12. Install the brake disc support, **(1)**, into the axle housing, **(2)**.

NOTE: *The WORKMASTER 45tractor uses a low duty brake disc support and the WORKMASTER 55 uses a heavy duty brake disc support.*



33084220 9

13. Install a new brake rod rubber bellow, **(1)**, onto the axle housing, **(2)**.
14. Install the rear brake rod, **(3)**, through the anti-dust seal, **(1)**, and then install the dust cover, **(4)**, onto the brake rod, **(3)**.
15. Install the spring, **(5)**, onto the rear brake rod, **(3)**.
16. Screw the tie rod, **(6)**, onto the end of the brake rod, **(3)**.

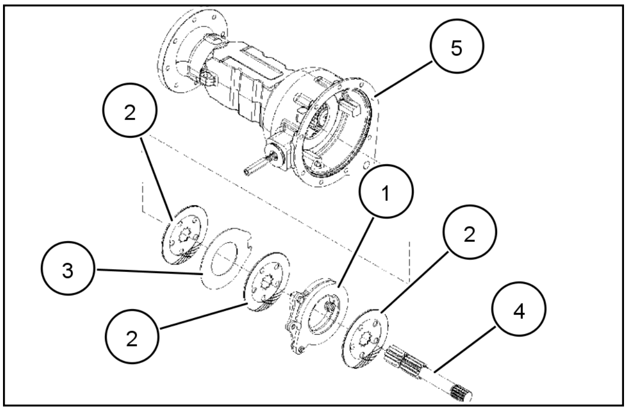


20099979 10

17. Install the brake actuator, **(1)**, brake discs, **(2)**, stator, **(3)**, and differential shaft, **(4)**, back into the axle housing, **(5)**.

NOTE: *Before installing the brake actuator, stator and brake discs, install the brake rod linkage pin to the rear brake rod.*

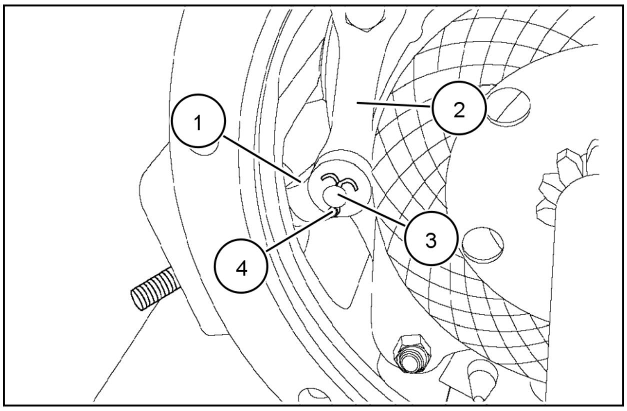
NOTICE: *When installing the brake actuator, stator, and brake discs back into the axle housing, make sure the actuator, stator, and brake discs are properly aligned with the brake disc support.*



33083226 11

18. Align the rear brake rod, **(1)**, with the actuator, **(2)**, and secure using the brake rod linkage pin, **(3)**, and cotter pin, **(4)**.

NOTE: *In order to slide the brake rod linkage pin through the rear brake rod and brake actuator. The differential shaft, brake discs, stator, and brake actuator will need to be pulled out from the axle housing to allow clearance.*



33083225 12

REAR AXLE - Install Housing - Left-hand side or right-hand side

Prior operation:
REAR AXLE - Assemble (D.12.A)

⚠ WARNING ⚠

Handle all parts carefully. Do not put your hands or fingers between parts. Always wear suitable safety items such as fitted clothing, safety goggles, gloves, shoes, etc. Failure to comply could result in death or serious injury.

M954A

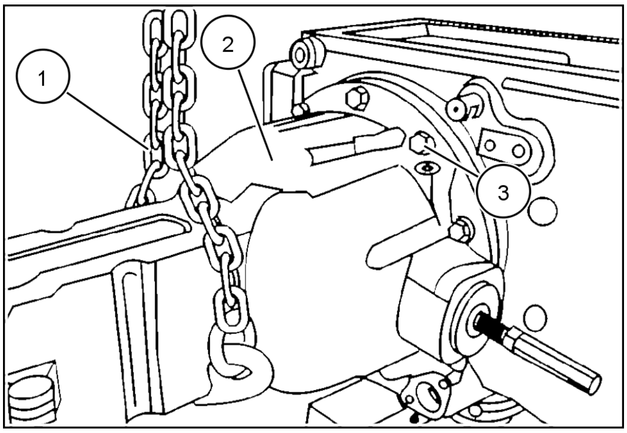
⚠ DANGER ⚠

Lift and handle all heavy components using lifting equipment of appropriate lifting capacity. Make sure that units or parts are supported by suitable slings or hooks. Make sure that no-one is in the vicinity of the load to be lifted. Failure to comply could result in serious injury or death.

B012

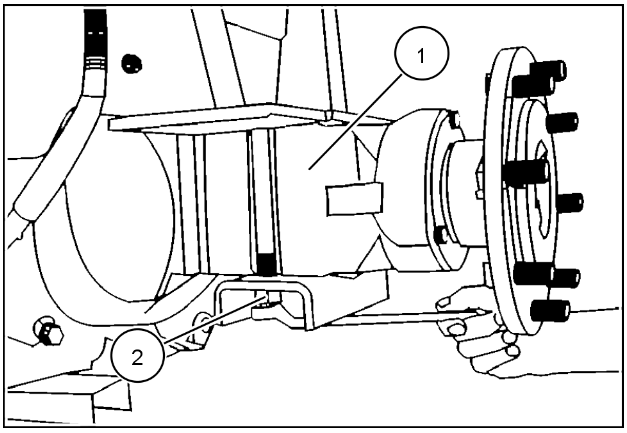
NOTE: *The left-hand side and right-hand side rear axles are not identical. Each axle has a stamp on the top which identifies which side the axle goes on.*

1. Wrap a suitable chain or nylon strap, **(1)**, around the rear axle housing, **(2)**, and raise it using a hoist.
2. Secure rear axle housing with M12 retaining bolts, **(3)**, to the transmission/differential housing. Tighten the bolts to the required torque.



20097830 1

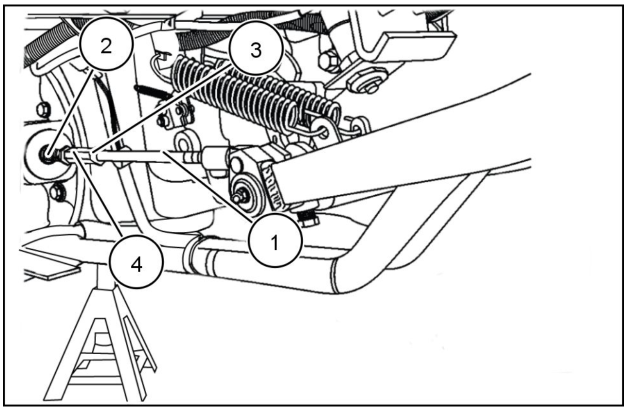
3. Secure the ROPS and fenders on both the left-hand side and right-hand side of the rear axle, **(1)**, using the bolts, **(2)**.



20097821 2

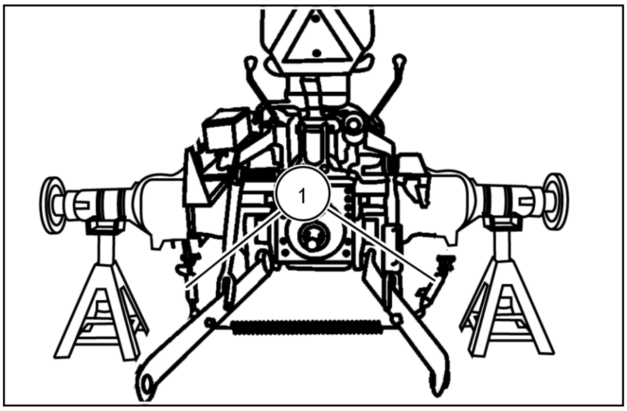
4. Connect the front bake rod, **(1)**, to the rear brake rod, **(2)**, by turning the turn buckle, **(3)** until the brake free play is achieved. Tighten the M12 jam nut, **(4)**.

NOTE: *The brake rods have left-handed threads.*



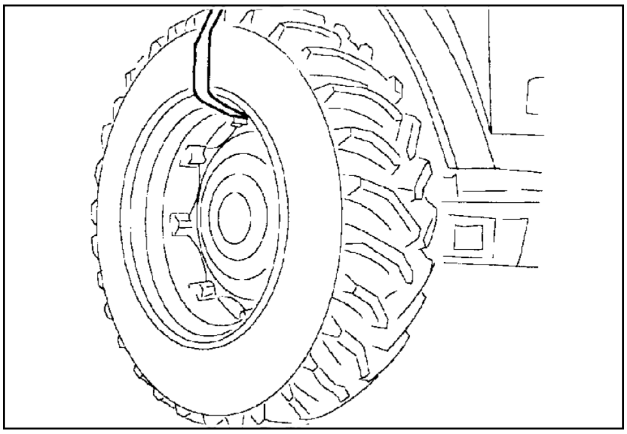
20102977 3

5. Attach the lower lift links, **(1)**, to the rear axles.



20102976 4

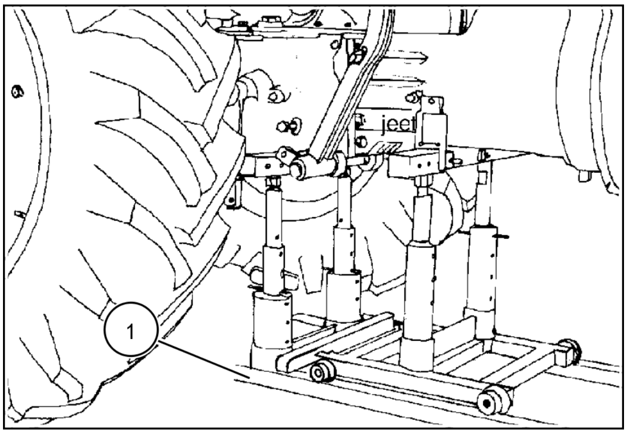
6. Fill the combined transmission / differential housing and rear axle housing with the recommended oil and recommended quantity.
7. Install both left-hand side and right-hand side wheels.



20096210 5

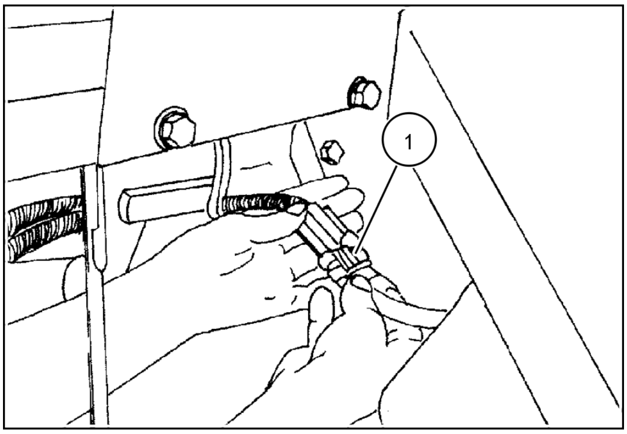
8. Use a floor jack to raise the rear of the tractor and remove the jack stands or splitting trolley, **(1)**, from under the rear of the tractor.

NOTE: *Place suitable blocks in front and behind the front wheels.*



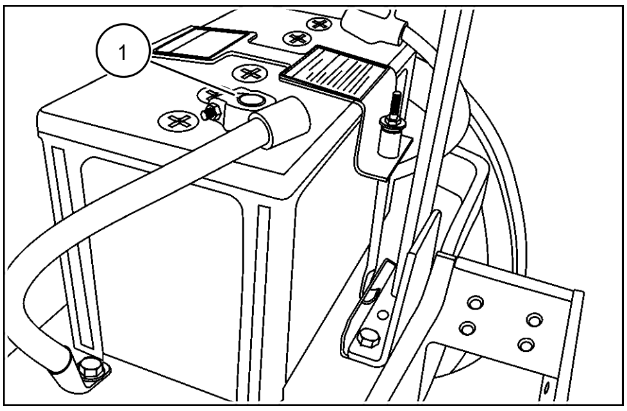
20096209 6

9. Connect the electrical connections, **(1)**, between left-hand side and right-hand side fenders.



20096205 7

10. Connect the negative battery cable to the negative battery terminal, **(1)**.



20099930 8

Differential - Disassemble

Prior operation:
Bevel gear - Remove Ring gear and differential assembly (D.12.A)

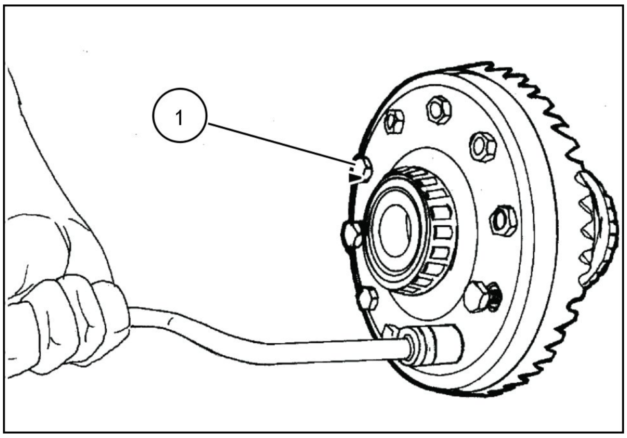
With the assembly removed from the rear axle housing , proceed as follows :

⚠ WARNING ⚠

Handle all parts carefully. Do not put your hands or fingers between parts. Always wear suitable safety items such as fitted clothing, safety goggles, gloves, shoes, etc. Failure to comply could result in death or serious injury.

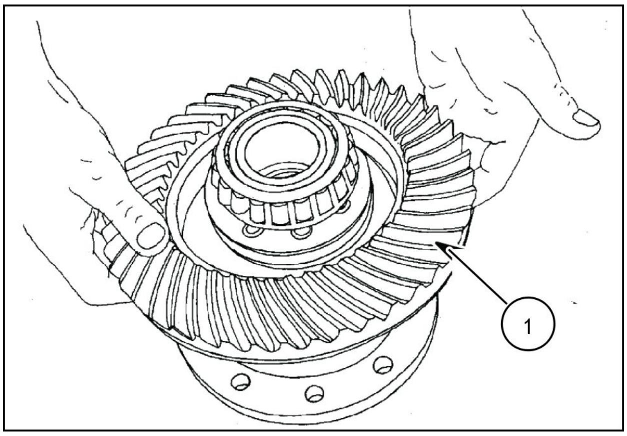
M954A

1. Remove the ring gear attaching bolts, **(1)** .



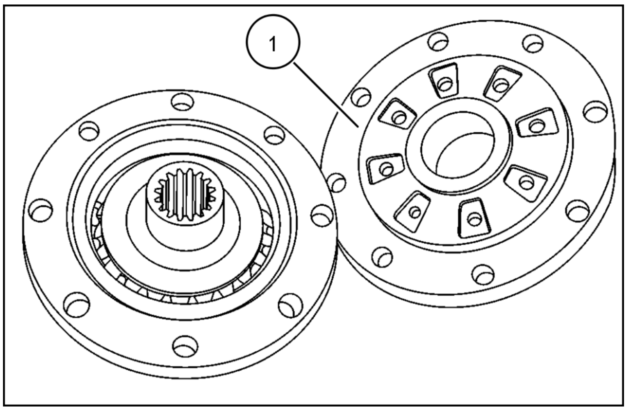
20093425 1

2. Remove the ring gear, **(1)**, from the differential gear case.



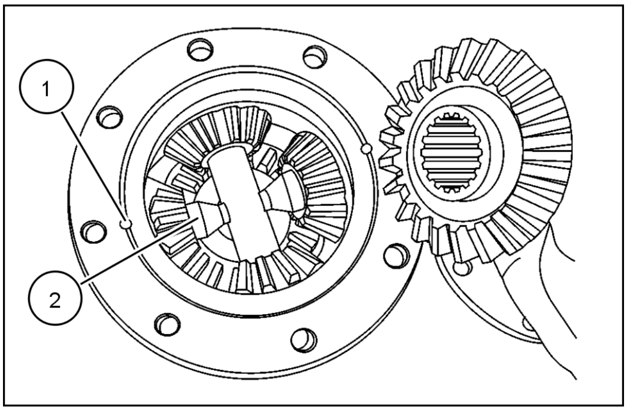
20093426 2

3. Lift the cover, **(1)**, as shown to get access to the differential gears.
4. Remove the thrust washer and left-hand side gear, **(1)**, from the differential gear case.



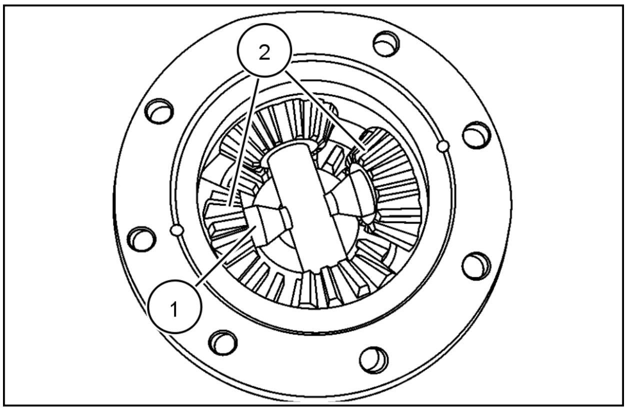
20099985 3

5. Insert a punch, **(1)**, in the roll pin access hole and drive the roll pin out of the two short differential pins, **(2)**, secured in the differential gear case.



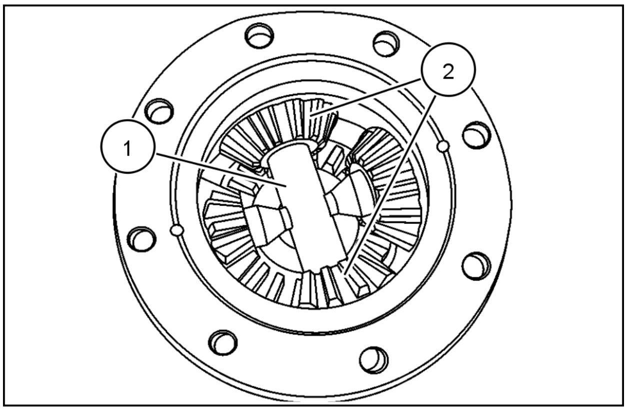
20099986 4

6. Remove the two short differential pins, **(1)**, from the differential gear case.
7. Remove the two pinion gears and the thrust washers, **(2)**, from the differential gear case.



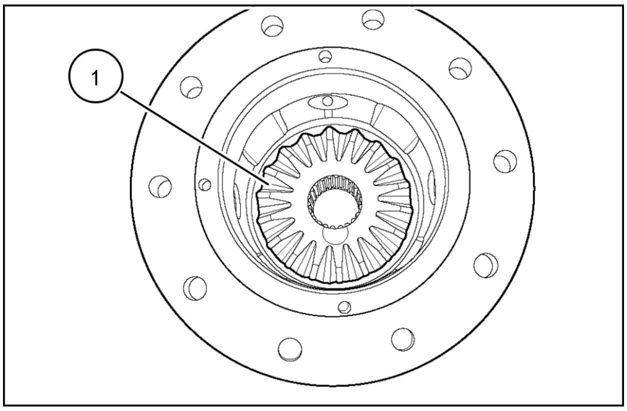
20099987 5

8. Remove the long differential pin, **(2)**, from the differential gear case.
9. Remove the two pinion gears and the thrust washers, **(3)**, from the differential gear case.



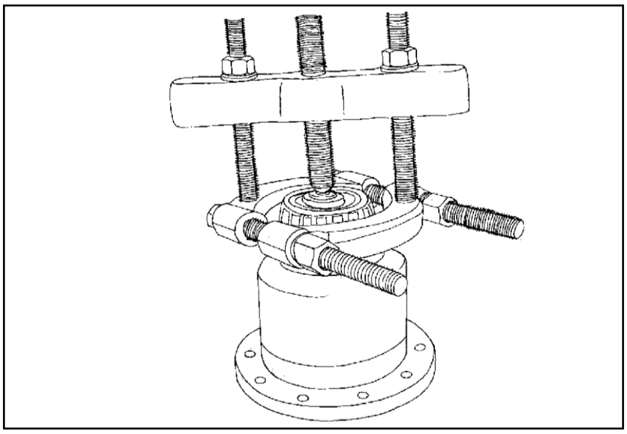
20099987 6

10. Remove the right-hand side gear and the thrust washers, **(1)**, from the differential gear case.



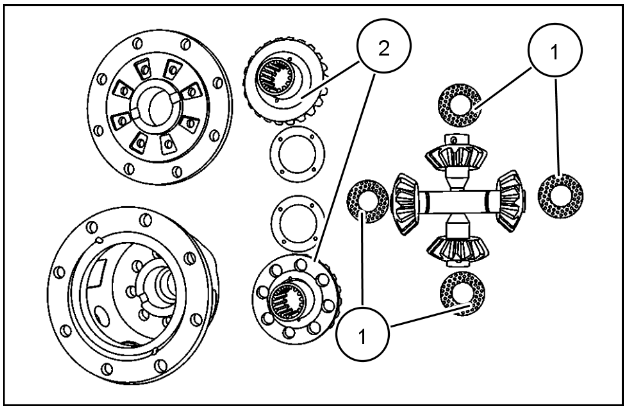
83065993 7

11. Using a suitable puller or hydraulic press and bearing splitter move the bearings from the differential gear case and cover.



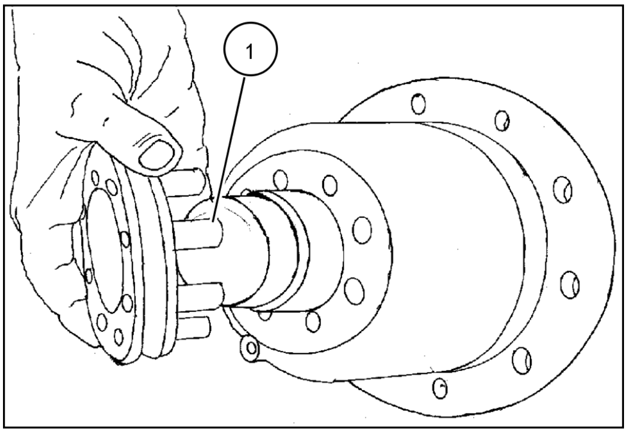
20097946 8

__NOTE:__ The four pinion gears, __(1)__, and side gear, __(2)__, have thrust washers with same thickness.



20099980 9

12. Remove the differential lock clutch, **(1)**, from the differential gear case.



20097947 10

Next operation:
Differential - Inspect (D.12.A)

Differential - Inspect

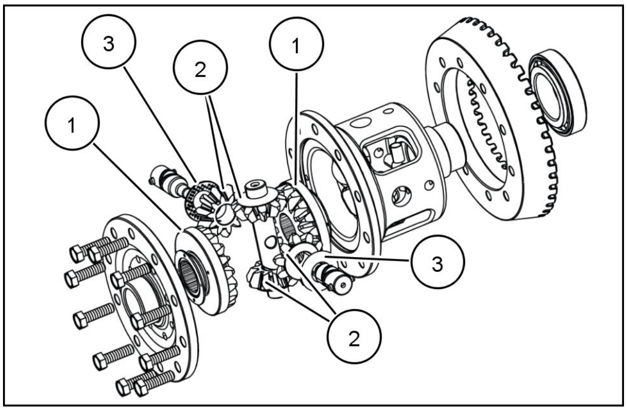
Prior operation:
Differential - Disassemble (D.12.A)

1. Inspect the side gears, **(1)**, pinion gears, **(2)**, and thrust washers, **(3)**, for excessive wear. If any wear and/or damage is found, replace the components as a complete set.

⚠ WARNING ⚠

Always use suitable tools to align holes. DO NOT USE HAND OR FINGERS. Failure to comply could result in death or serious injury.

B020A



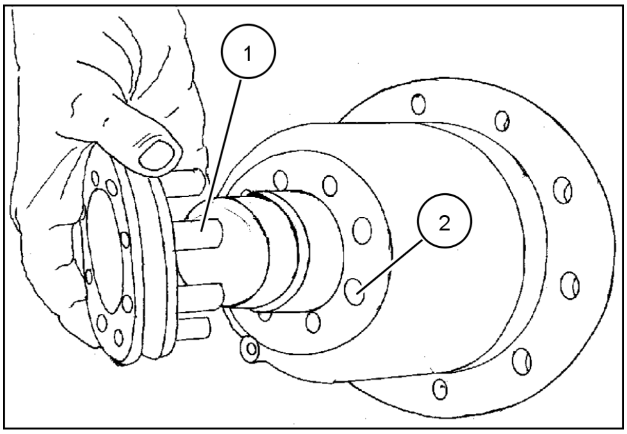
20099876 1

Next operation:
Differential - Backlash (D.12.A)

Differential - Assemble

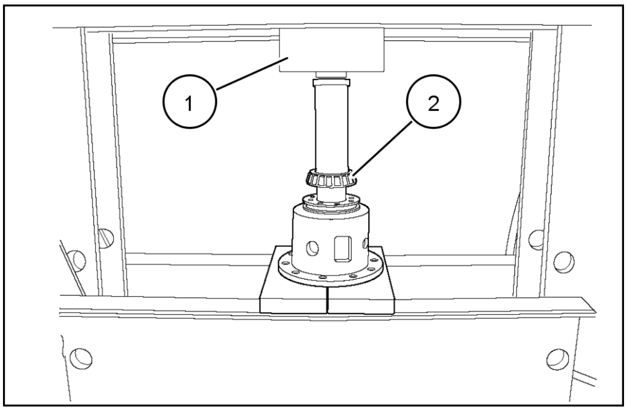
Prior operation:
Differential - Backlash (D.12.A)

1. Install the differential lock clutch, **(1)**, into the holes, **(2)**, on the differential gear case.



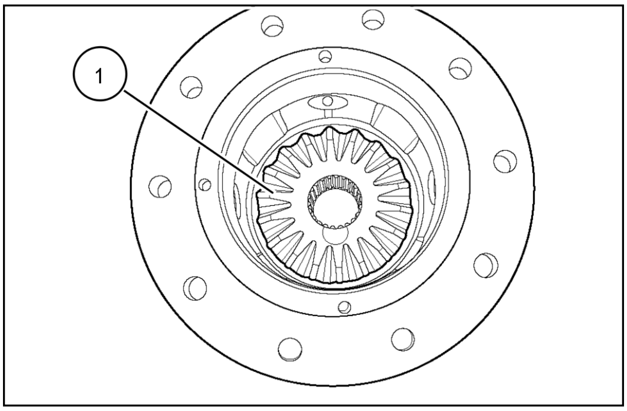
20097947 1

2. Using a suitable hydraulic press, **(1)**, press the bearings, **(2)**, back onto the differential gear case and cover.



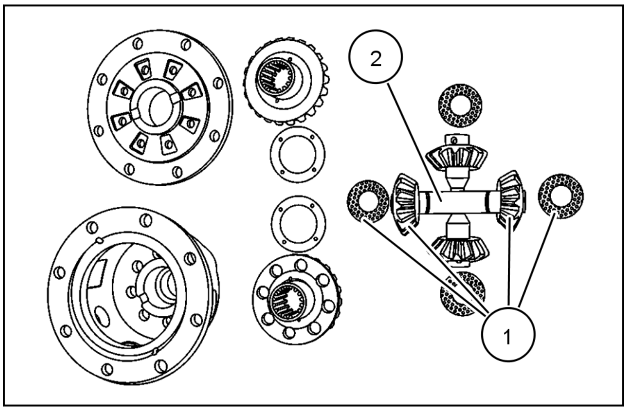
83065995 2

3. Install the thrust washer and right-hand side gear, **(1)**, into the differential gear case.



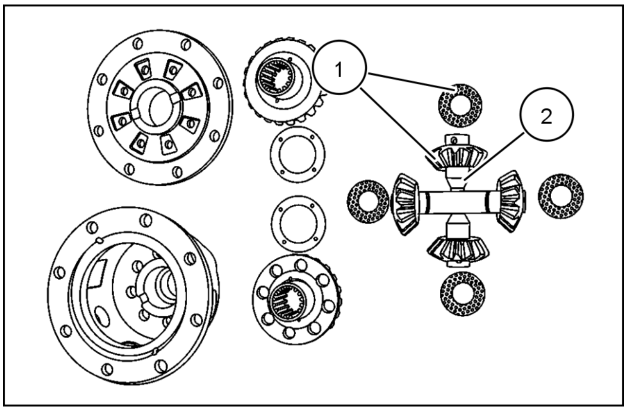
83065993 3

4. Install two pinion gears and the thrust washers, **(1)**.
5. Install the long differential pin, **(2)**, in the differential gear case and through the pinion gears and thrust washers.



20099980 4

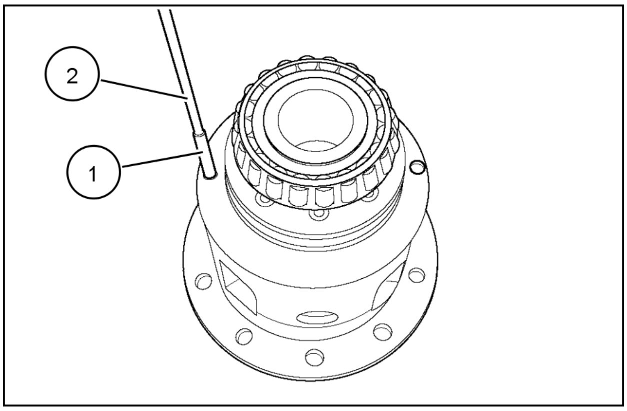
6. Install one pinion gear and the thrust washer, **(1)**.
7. Install one of the short differential pins, **(2)**, through the thrust washer and pinion gear and into the long differential pin.



20099980 5

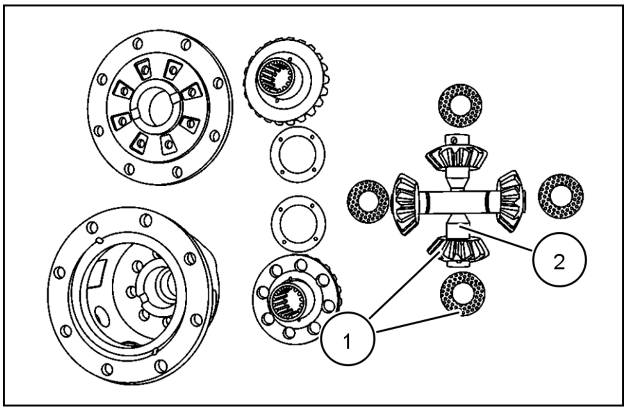
8. Install a roll pin, **(1)**, in the hole in the differential gear case to secure the short differential pin.
9. Use a punch, **(2)**, to install the roll pin into the hole top approximately to **31 mm** (**1.22 in**).

NOTE: *The figure shown is for reference only. The hole location may vary according to which gears are being installed.*



83065997 6

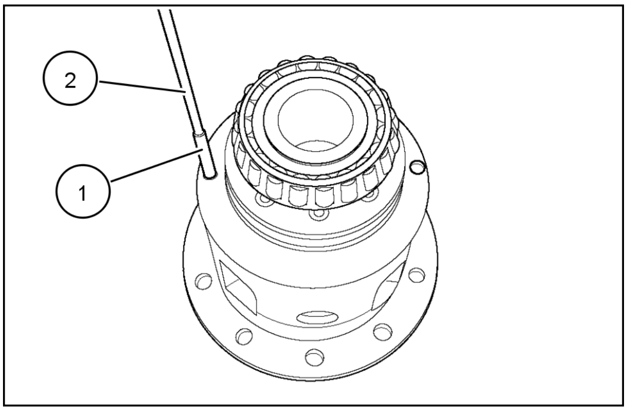
10. Install the remaining pinion gear and the thrust washer, **(1)**.
11. Install the remaining short differential pin, **(2)**, through the thrust washer and pinion gear and into the long differential pin.



20099980 7

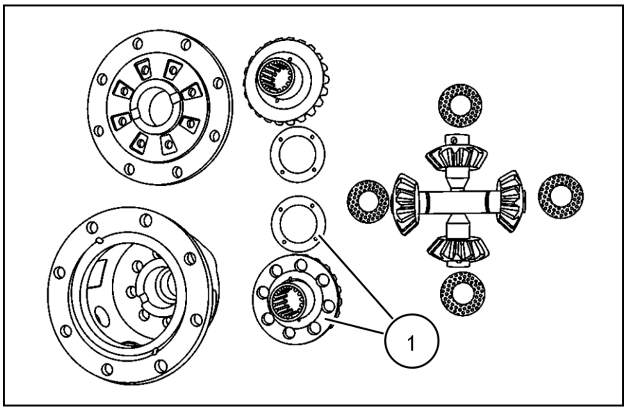
12. Install a roll pin, **(1)**, in the hole in the differential case to secure the short differential pin.
13. Use a punch, **(2)**, to install the roll pin into the hole top approximately to **31 mm** (**1.22 in**).

NOTE: *The figure shown is for reference only. The hole location may vary according to which gears are being installed.*



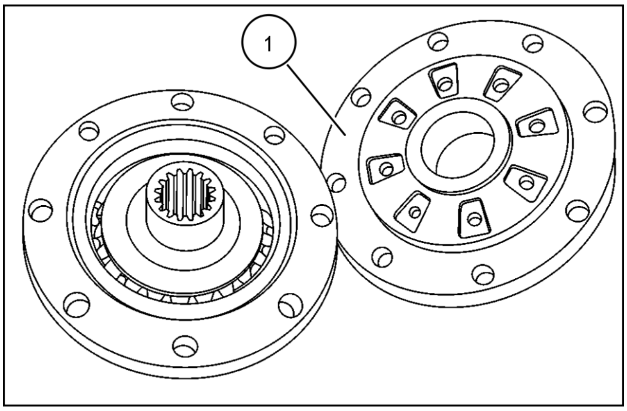
83065997 8

14. Install the thrust washer and the left-hand side gear, **(1)**.



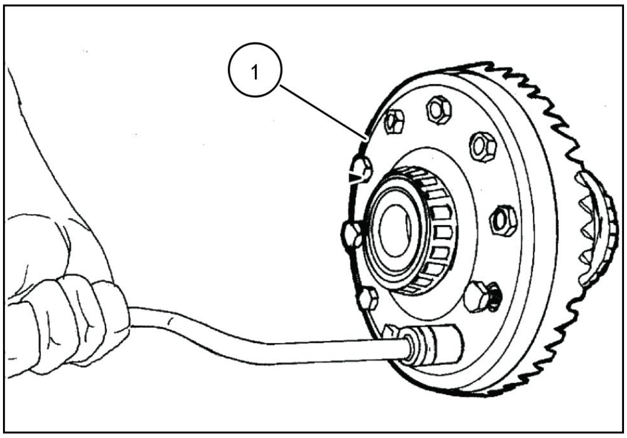
20099980 9

15. Install the cover, **(1)**, on the differential gear case.



20099985 10

16. Install the ring gear onto the differential gear case.
17. Apply **LOCTITE® 271** thread sealant to the bolts, **(1)**, that secure the ring gear. Torque the bolts to **78 N·m** (**58 lb ft**).



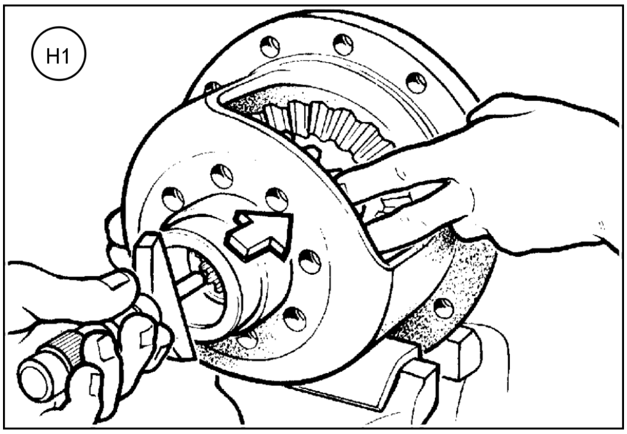
20093425 11

Differential - Backlash

Prior operation:
Differential - Inspect (D.12.A)

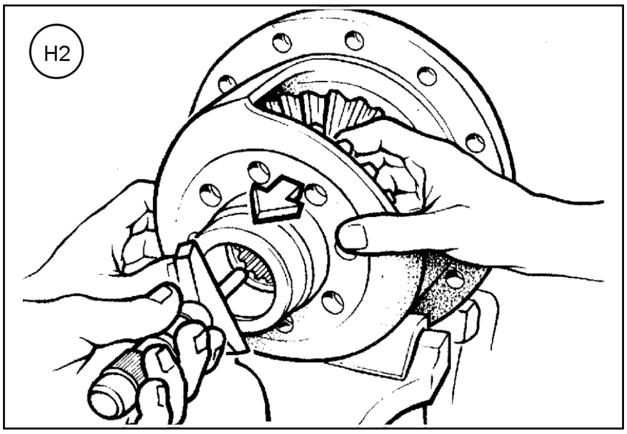
1. Fit the two side gears in the differential carrier without the shims .
2. Install differential pinions complete with thrust washer and journal and tighten bolts a few turns to prevent journal work out.
3. Bring left-hand side gear into full contact with differential pinion.
4. Using a depth gauge measure dimension (H1) at two diametrically opposed points and average the two readings. Then push side gear into contact with differential carrier and measure dimension (H2).
5. Repeat the same operations on right-hand side gear.

End float of each side gear without the balk ring must be:
Gl or Gr = H1 -H2
where:
Gl = Left-hand side gear end float;
Gr = Right-hand side gear end float;



20097948 1

H1 and H2 = Dimensions measured on left-hand or right-hand side gears.
Normal differential pinion and side gear backlash is **0.15 mm** (**0.006 in**).
Note that the average ratio normal backlash to the equivalent side gear end float is **1.7 mm** (**0.067 in**).
Side gear end float corresponding to normal backlash will be:
0.15 x 1.7 = **0.25 mm** (**0.010 in**)0.25 mm
Consequently the shim thickness required in the differential carrier is given by:
Shim (Left) = Gl - 0.25 (for left-hand side gear)
Shim (Right) = Gr - 0.25 (for right-hand side gear)
Available shims are **1.2 mm** (**0.047 in**) to **2 mm** (**0.079 in**); install closest to calculated thickness.



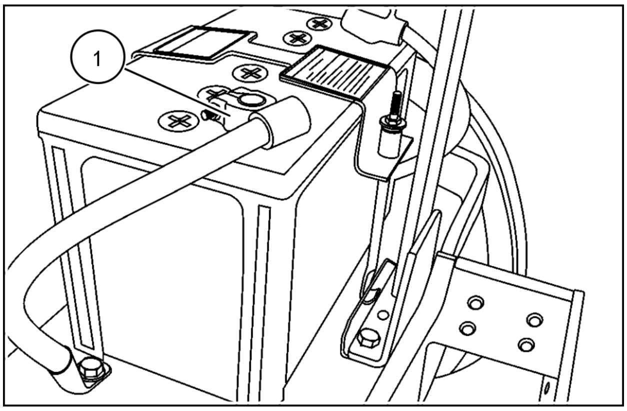
20097949 2

Next operation:
Differential - Assemble (D.12.A)

Bevel gear - Remove Ring gear and differential assembly

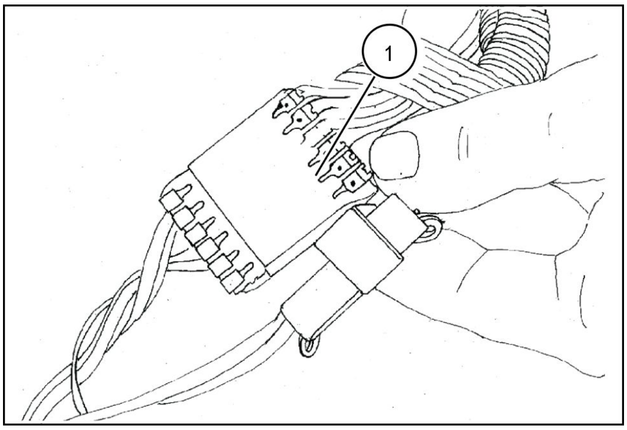
To remove the ring gear and differential assembly, the rear axle housings and PTO assembly has to be removed. Remove the rear axle housing as follows:

1. Disconnect the negative battery cable, **(1)**, from the negative battery terminal.



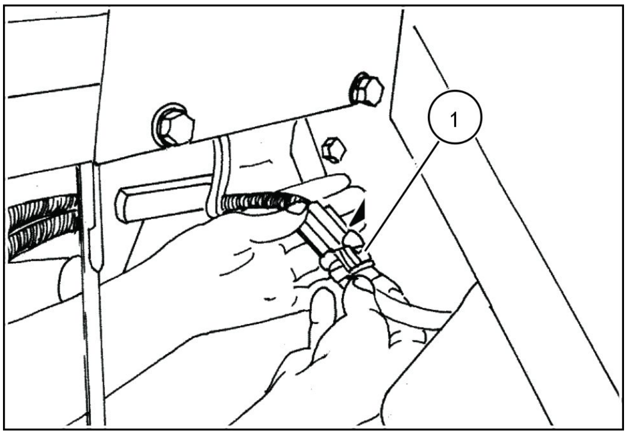
20099930 1

2. Disconnect the rear electrical connection, **(1)**, under the rear hood console.



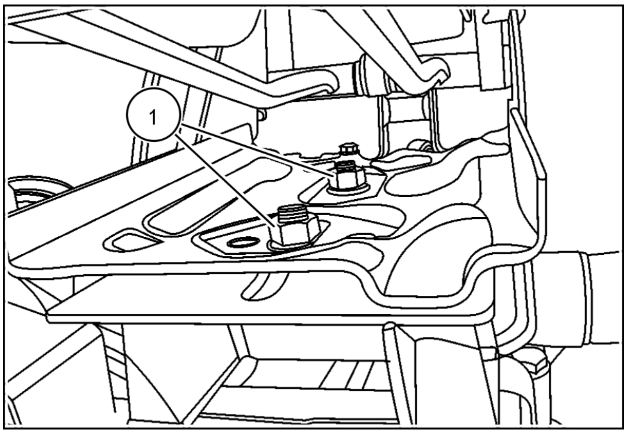
20093436A 2

3. Disconnect the electrical connection, **(1)**, between left-hand side and right-hand side fenders.



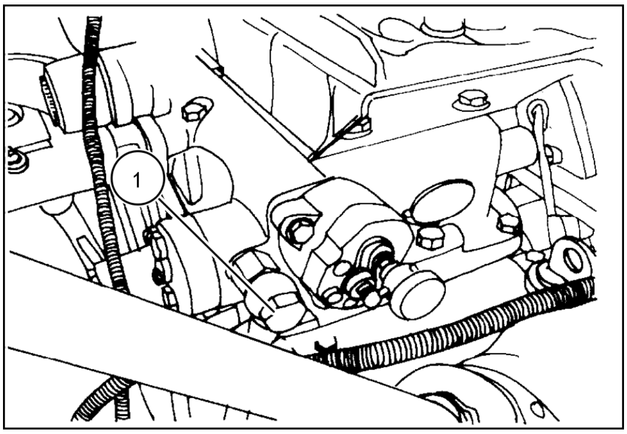
20093437 3

4. Loosen the bolts, **(1)**, and remove operator seat from the hydraulic housing.



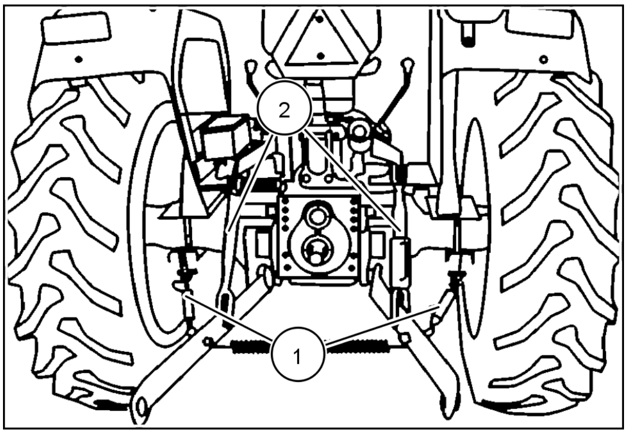
20097825 4

5. Disconnect hydraulic lines, **(1)**, connecting pump and hydraulic distributor.



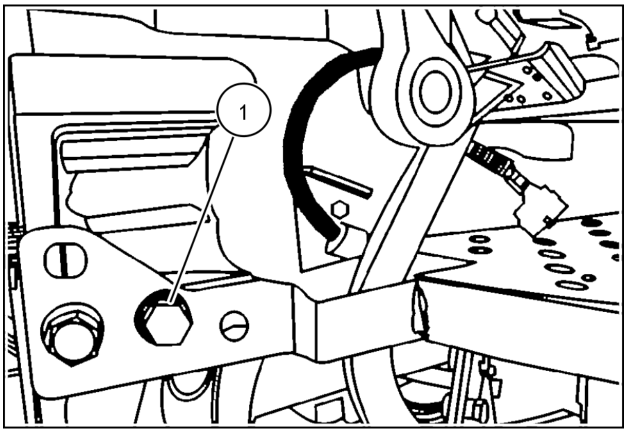
20097480 5

6. Remove the lower lift links, **(1)**, from the rear axles.
7. Remove the lift rods, **(2)**, from the lift housing.



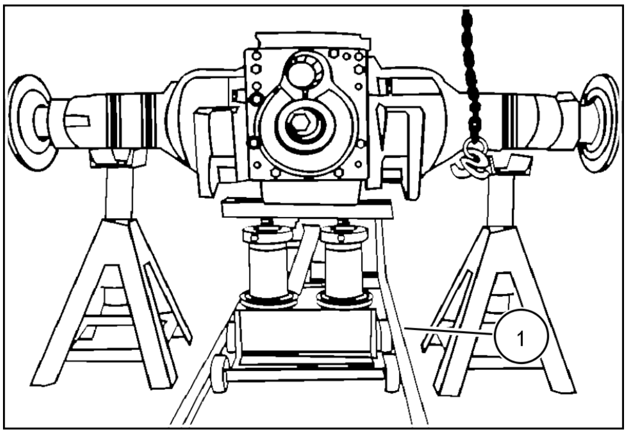
20097823 6

8. Loosen bolts, **(1)**, securing foot rest to fender on both sides.



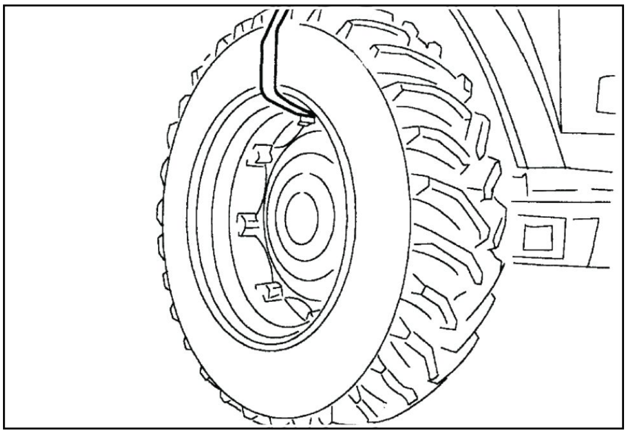
20097820 7

9. Place suitable blocks in front and behind the front wheels.
10. Use a floor jack to raise the rear of the tractor and place suitable jack stands or a splitting trolley, **(1)**, under the rear of the tractor.



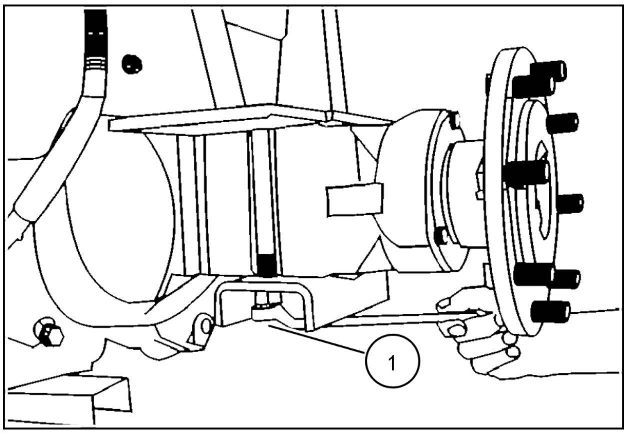
20097933 8

11. Remove both left-hand side and right-hand side wheels.



20093444 9

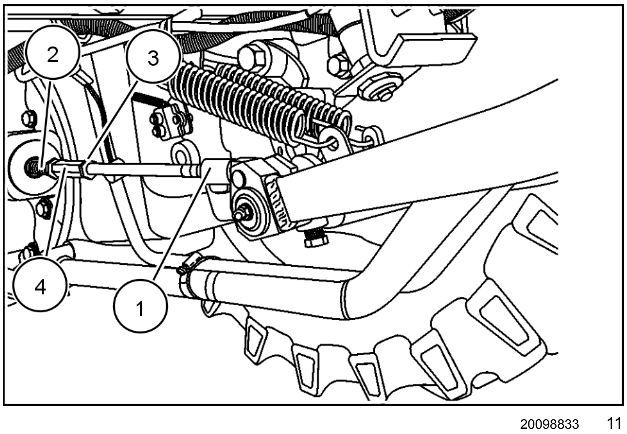
12. Drain the oil from the combined transmission/differential and rear axle housing into a suitable container.
13. Loosen the bolts, **(1)**, and remove fenders from both sides.



20097821 10

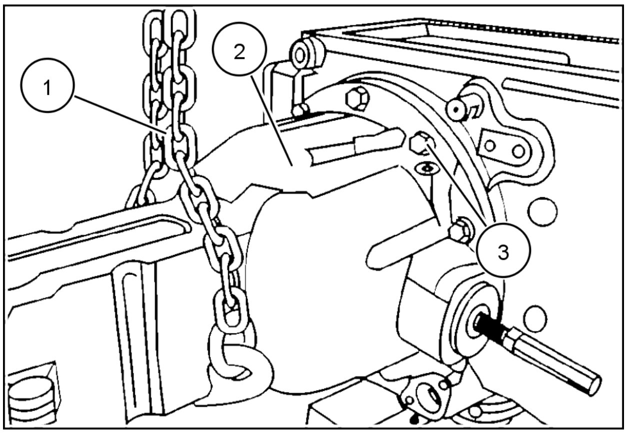
14. Disconnect the front brake rod, **(1)**, from the rear brake rod, **(2)**, by loosening the M12 jam nut, **(3)**. Turn the turnbuckle, **(4)**, until it is removed from the front brake rod.

NOTE: *The brake rods have left-handed threads.*



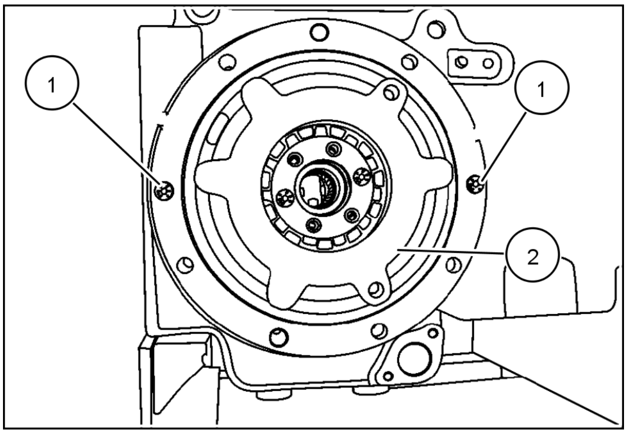
20098833 11

15. Wrap a suitable chain or nylon strap, **(1)**, around the rear axle housing, **(2)**, and connect it to a hoist. Remove the axle housing by removing the M12 retaining bolts, **(3)**.



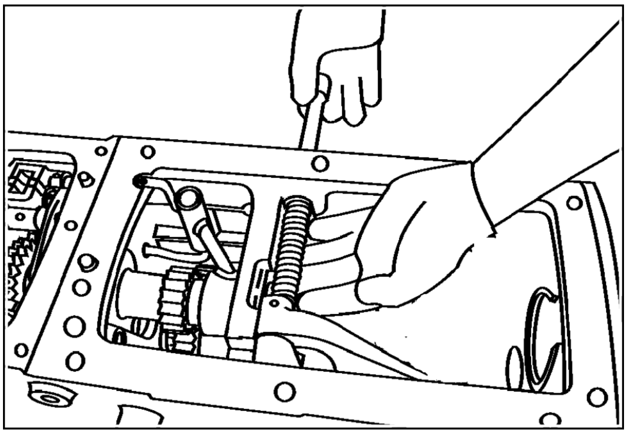
20097830 12

16. Repeat for the rear axle housing on the other side.
17. Remove the right-hand bearing carrier, **(1)**, by removing the countersunk socket head cap screws, **(2)**. Remove the O-rings from the housing and right-hand bearing carrier.



20097872 13

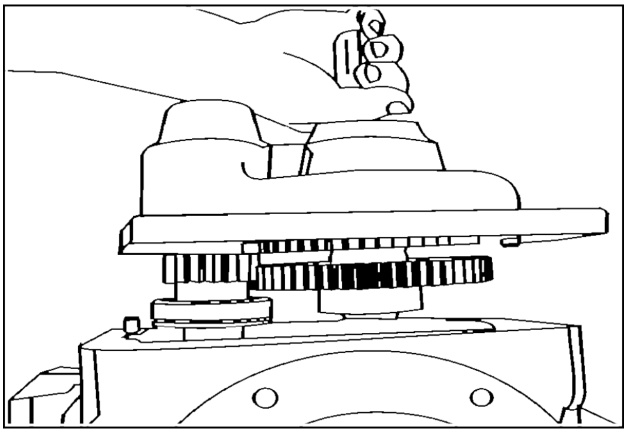
18. Loosen the bolts securing hydraulic lift housing to transmission housing. Lift the hydraulic lift assembly using suitable hoist and place it on a flat surfaced table.
19. Remove PTO engaging levers and differential lock as detailed in power take off section.



20097934 14

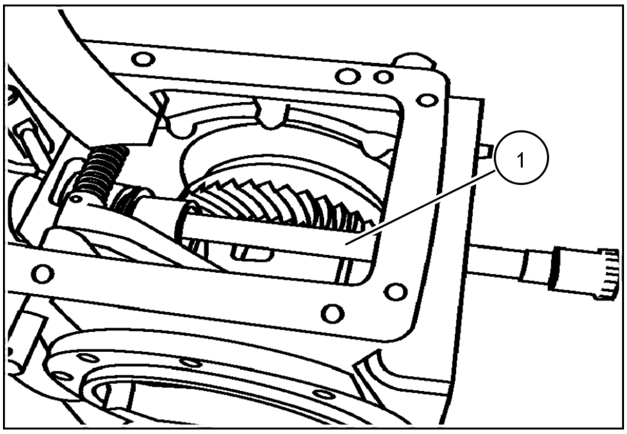
20. Loosen the rear PTO cover bolts and pull out the cover with the PTO output shaft.

NOTE: *Remove the PTO guard before removing the PTO cover.*



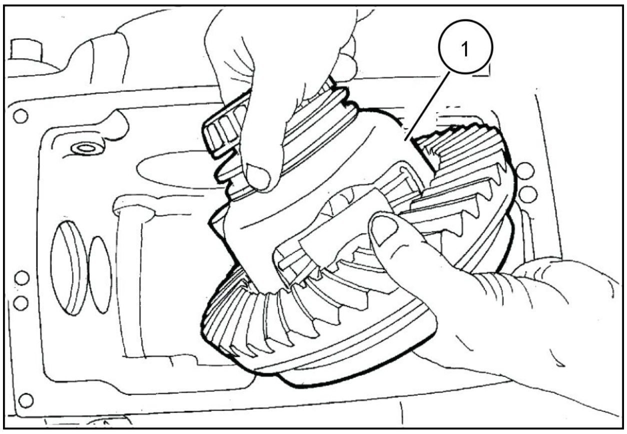
20097935 15

21. Remove PTO drive shaft, **(1)**.



20097936 16

22. Take out the differential assembly, **(1)**, along with ring gear.



20093424 17

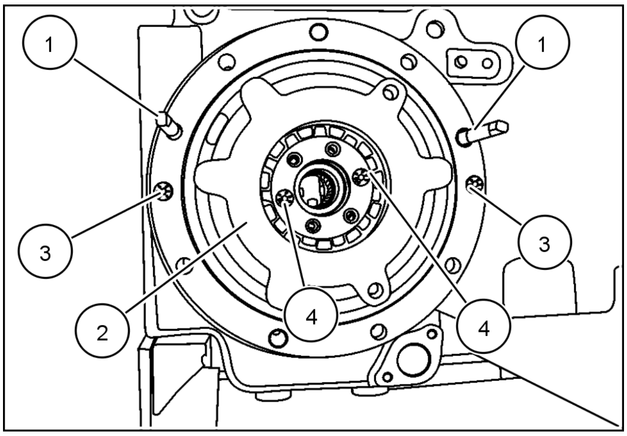
Next operation:
Differential - Disassemble (D.12.A)

Bevel gear - Backlash Adjustment of bevel drive shaft bearing preload and ring gear/pinion backlash adjustment

Prior operation:
Differential - Assemble (D.12.A)

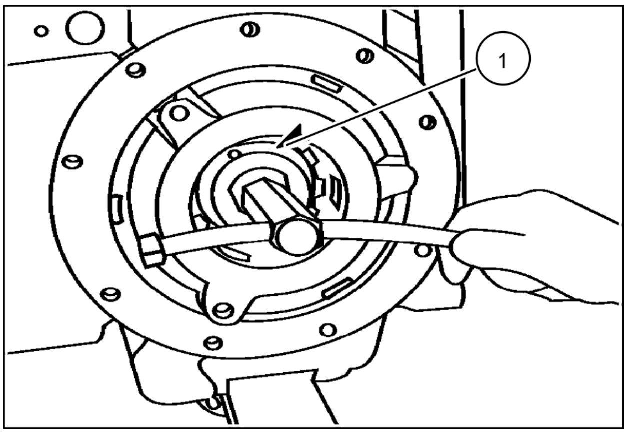
1. Fit the locator pins, **(1)**, and fit the cover plate, **(2)**, tighten the plate with allen screws, **(3)**, Screw out two allen srews, **(4)**, and remove lock plate from both sides

NOTE: *Place O-ring on the housing before fitting cover plate*



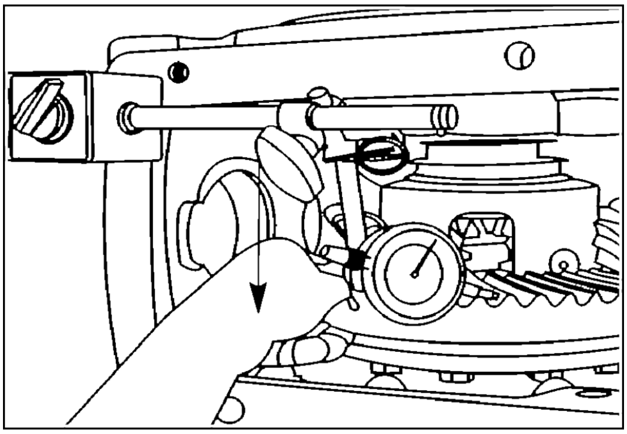
20098356 1

2. Tighten left-hand ring nut, **(1)**, using SST no 9971349 until minimum backlash between the bevel teeth is 1mm.



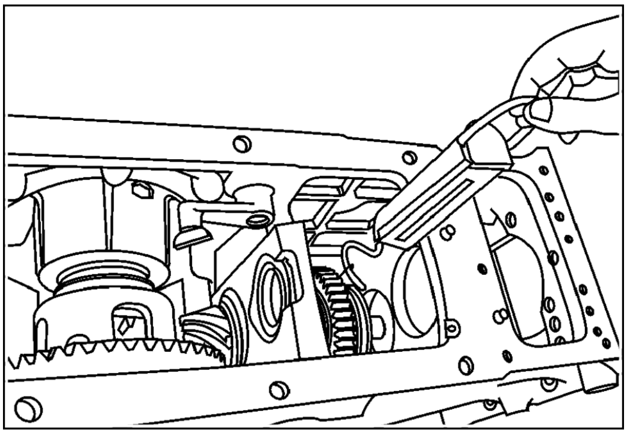
20098322 2

3. Measure the backlash using dial gauge. Backlash should be between **0.18 - 0.23 mm** (**0.007 - 0.009 in**)
4. If the backlash is less than **0.18 mm** (**0.007 in**), loosen the right-hand ring nut and tighten the lef-hand ring nut until the proper backlash is obtained.
5. If the backlash is more than **0.23 mm** (**0.009 in**), loosen the left-hand ring nut and tighten the right-hand ring nut until the proper backlash is obtained.



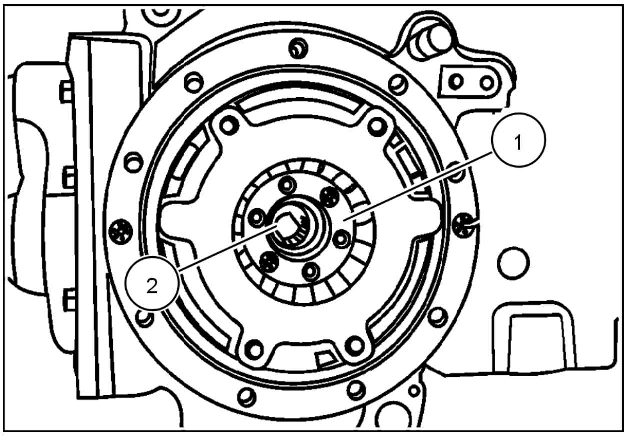
20098323 3

6. Measure the torque using a spring balance and chord wound around the sleeve of low gear it should be between **4 - 5.5 kgm**



20098324 4

7. Fit the lock plate **(1)** back on bearing support apply thread lock sealant **LOCTITE® 243** to the allen screws



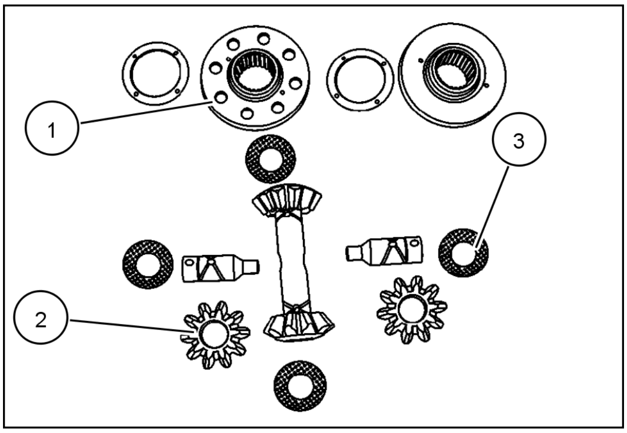
20098357 5

Next operation:
Bevel gear - Inspect (D.12.A)

Bevel gear - Inspect

Prior operation:
Bevel gear - Backlash Adjustment of bevel drive shaft bearing preload and ring gear/pinion backlash adjustment (D.12.A)

1. Inspect the side gears, **(1)**, differential gears, **(2)**, thrust washers, **(3)**, for excessive wear. If any wear and/or damage is found, replace the components as a complete set.



20097945 1

⚠ WARNING ⚠

Always use suitable tools to align holes. DO NOT USE HAND OR FINGERS. Failure to comply could result in death or serious injury.

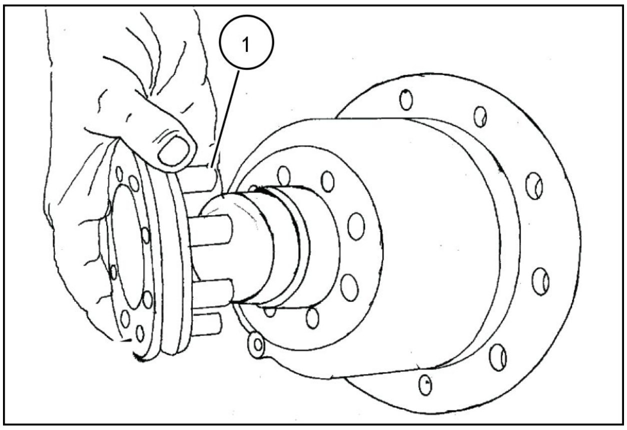
B020A

Next operation:
Bevel gear - Assemble (D.12.A)

Bevel gear - Assemble

Prior operation:
Bevel gear - Inspect (D.12.A)

1. Install the differential lock clutch **(1)** into the housing



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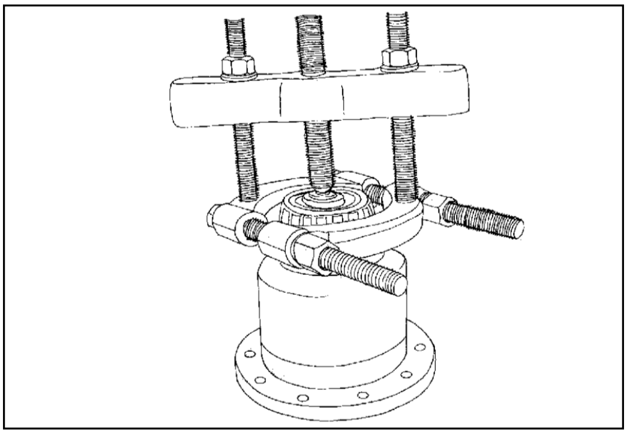
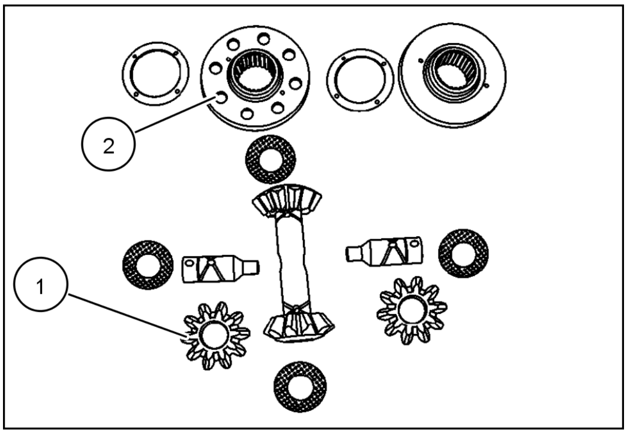
2. Using suitable tool install the bearings from both the sides.



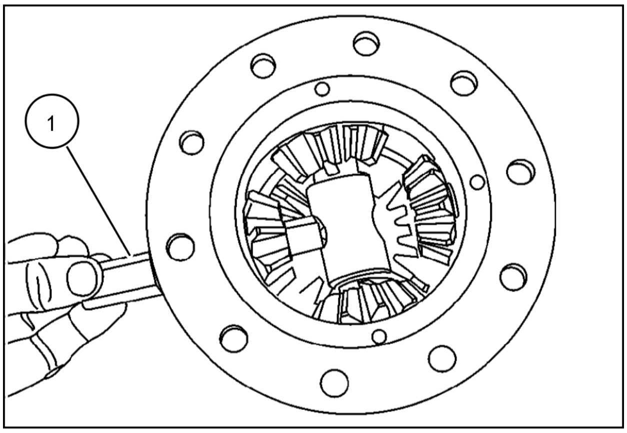
20097946 2

NOTE: *Four differential gear* ***(1)*** *and side gear* ***(2)*** *have thrust washers with same thickness.*



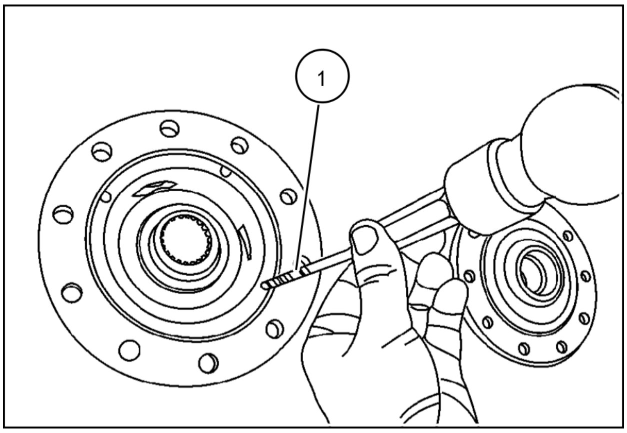
20097945 3

3. Install the pivot pin **(1)** & withdraw the side gears from the differential housing along with trust washer.



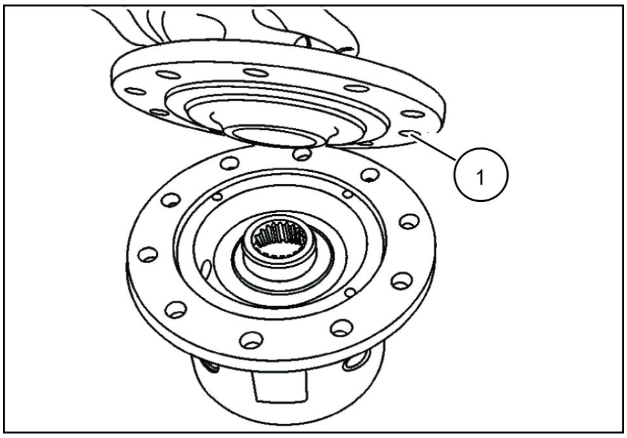
20097944 4

4. Install the locking pin **(1)** locking the differential gear pivot pin.



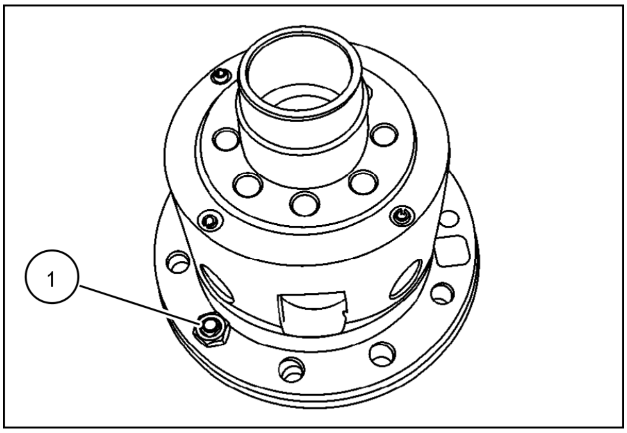
20097943 5

5. Lift the cover **(1)** as shown to get access to differential gears.



20093427 6

6. Fasten and install all the bolts **(1)** from the casing.



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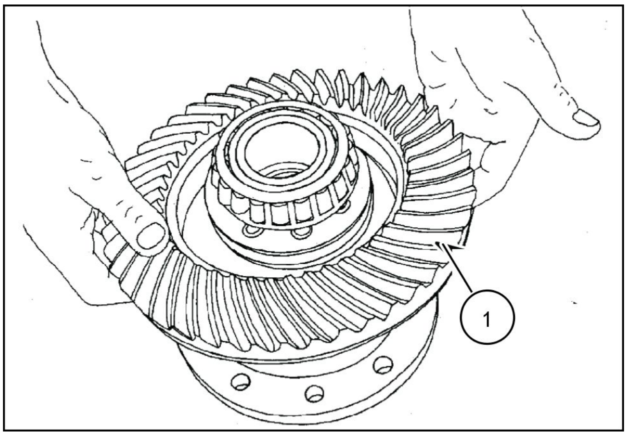
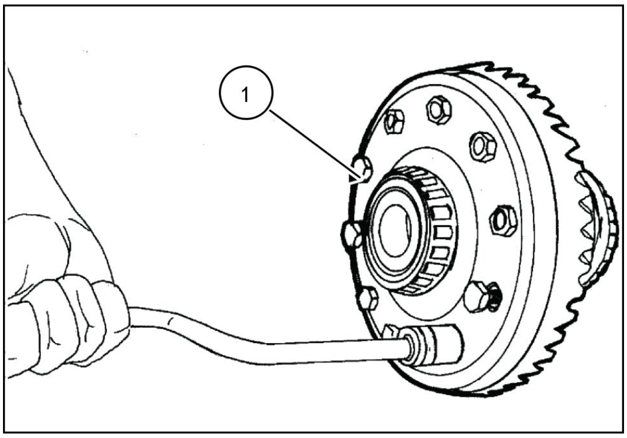
7. Install the crown wheel **(1)** from the differential housing .



20093426 8

8. Fasten the crown wheel attaching bolts **(1)**.



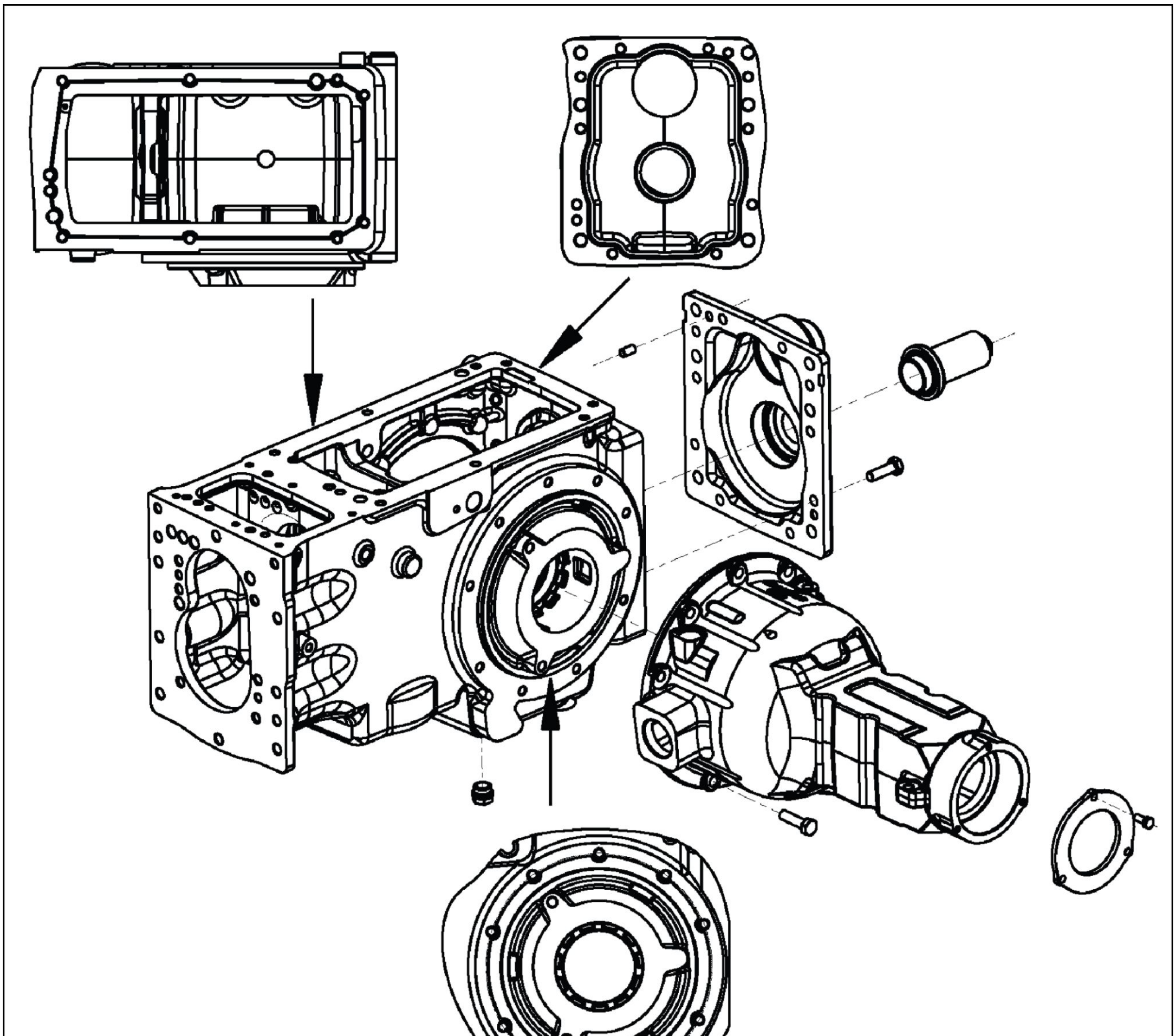
20093425 9

9. Set crown/Pinion backlash and total preload setting should be **4 - 6 kgm** (**29 - 43 ftlbs.**)
10. Use suitable tools to fit bearings.
11. Tighten to correct torques as detailed in **REAR AXLE - Torque (D.12.A)**
12. Use thread sealant **LOCTITE® 243** on crown wheel bolts.

Bevel gear - Install with differential housing

Prior operation:
Bevel gear - Remove Ring gear and differential assembly (D.12.A)

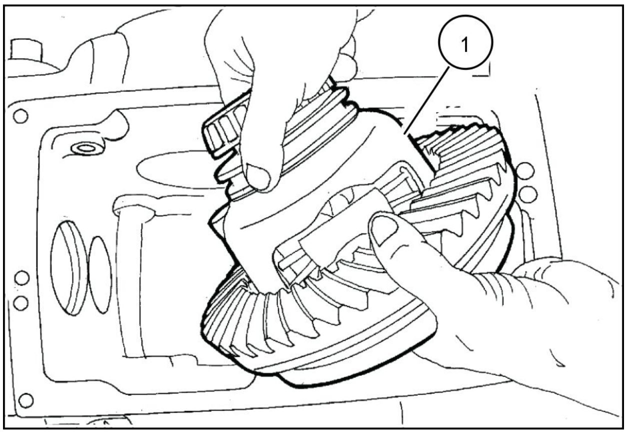
1. Check and replace seals if damaged.
2. Before assembling the housings, supports and covers, thoroughly clean and degrease mating surfaces and apply a **2 mm** (**0.1 in**) bead of **LOCTITE® 518** according to the patterns in figure.
3. Preload the taper roller bearings by adding and removing shims.
4. Set ring gear pinion backlash by following the procedure in "Ring Gear/Pinion Backlash and Total Preload Setting".



200900314 1

Pattern for application of sealant during installation of PTO cover, Final drive housing and Mechanical lift housing.

5. Install the differential assembly, **(1)**, into the housing.



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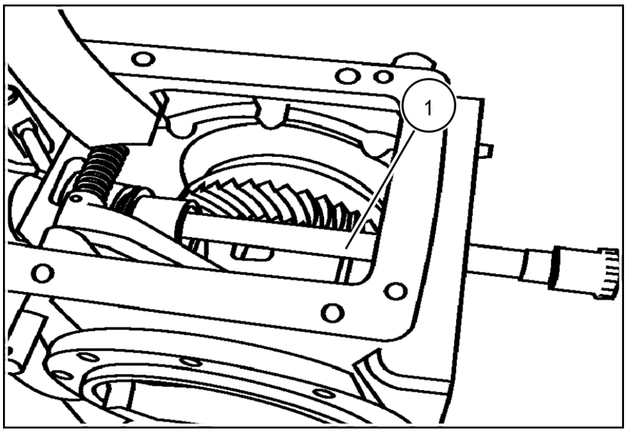
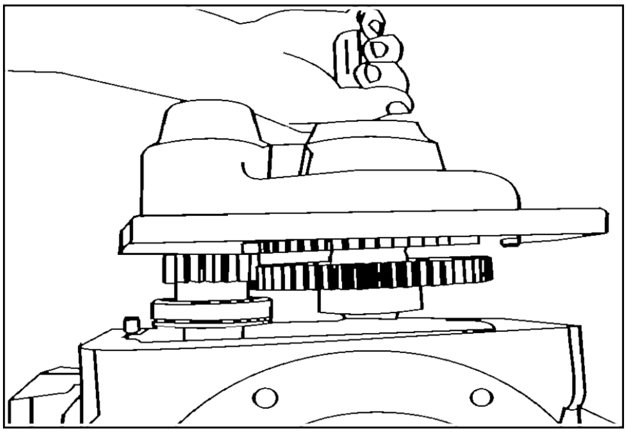
6. Reinstall the PTO shaft, **(1)**.



20097936 3

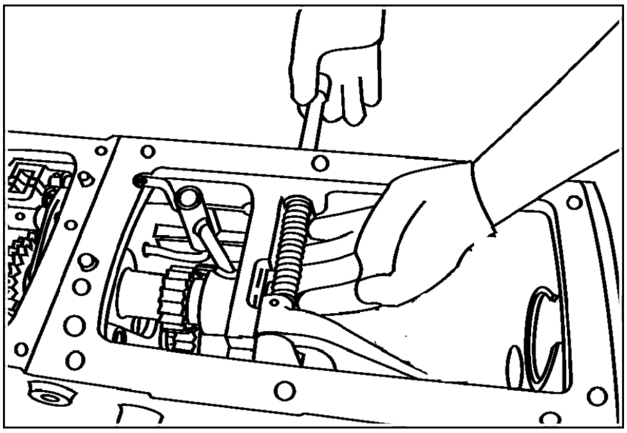
7. Push in the rear PTO cover with the PTO output shaft and tighten the rear PTO cover bolts.

NOTE: *Install the PTO cover before installing the PTO cover guard.*



20097935 4

8. Install the PTO engaging levers and differential lock as described in Power Take-Off section.



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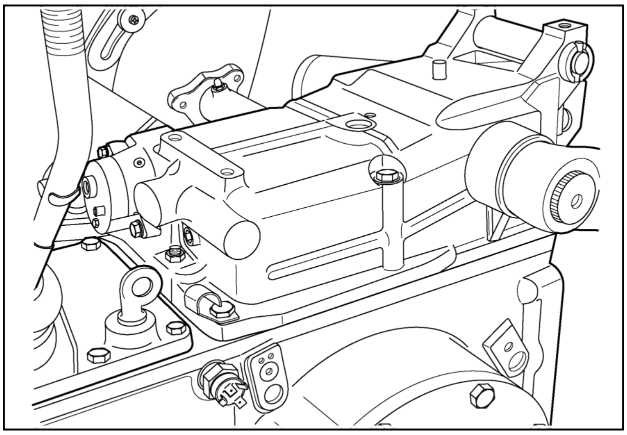
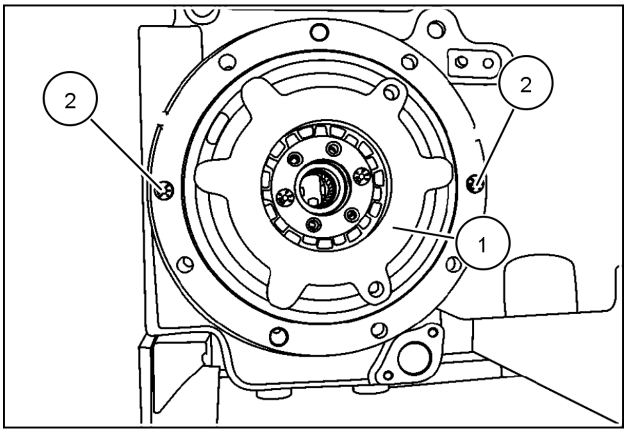
9. Use a suitable hoist to lift the hydraulic lift assembly and place it on the transmission housing. Secure the hydraulic lift assembly with the transmission housing by tightening the bolts.



86065628 6

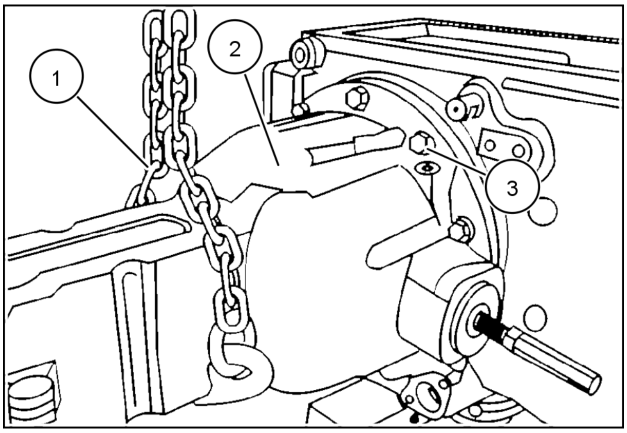
10. Install the right-hand bearing carrier, **(1)**, by securing the countersunk socket head cap screws, **(2)**. Install O-rings in the housing and right-hand bearing carrier.

11. Repeat for rear axle housing on the other side.



20097872 7

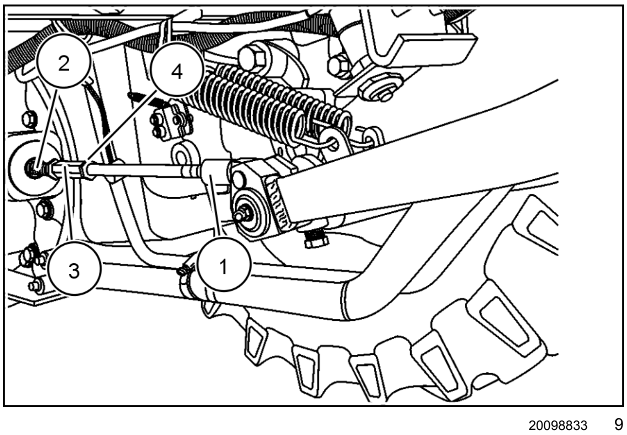
12. Wrap a suitable chain or nylon strap, **(1)**, around the rear axle housing, **(2)**, and connect it to a hoist. Install the rear axle housing by tightening the M12 retaining bolts, **(3)**.



20097830 8

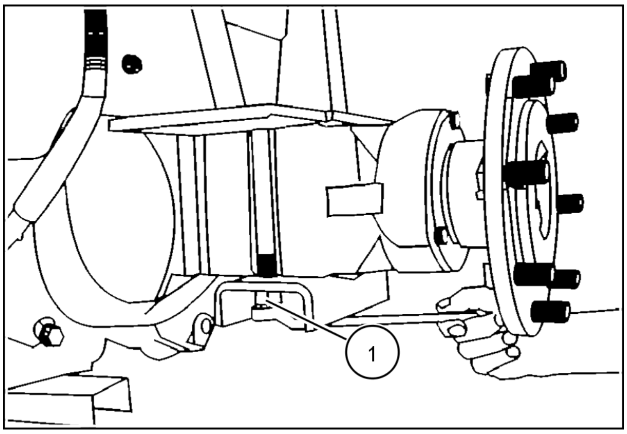
13. Connect the front brake rod, **(1)**, to the rear brake rod, **(2)**, by turning the turnbuckle, **(3)**. Tighten the M12 jam nut, **(4)**.

NOTE: *The brake rods have left-handed threads.*



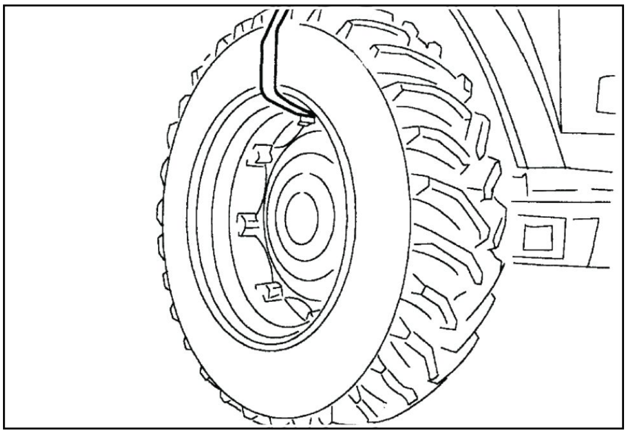
20098833 9

14. Secure the fenders and ROPS hardware, **(1)**, on both sides.



20097821 10

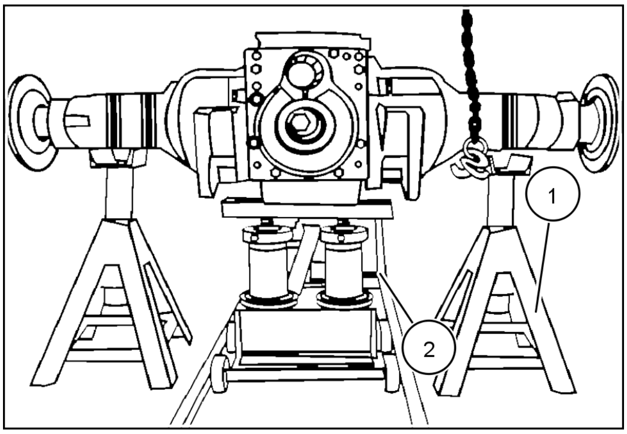
15. Install both left-hand side and right-hand side wheels.



20093444 11

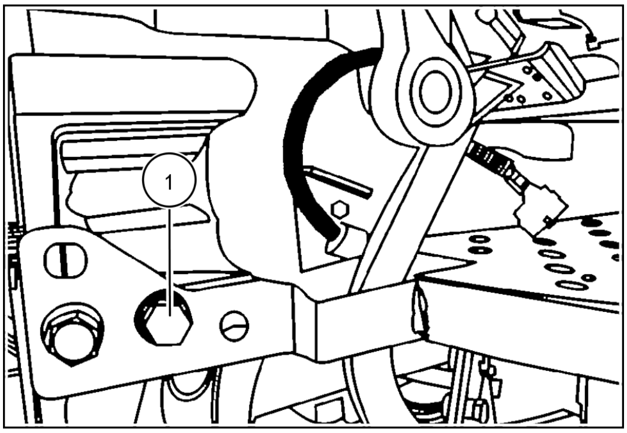
16. Place suitable blocks in front and behind the front wheels.

17. Use floor jack, **(1)**, to raise the rear of the tractor and place suitable jack stands or a splitting trolley, **(2)**, under the rear of the tractor.



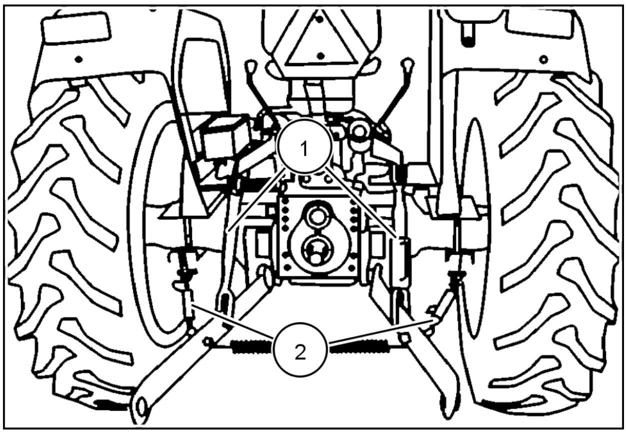
20097933 12

18. Tighten the bolts, **(1)**, securing the foot rest to fender on both sides.



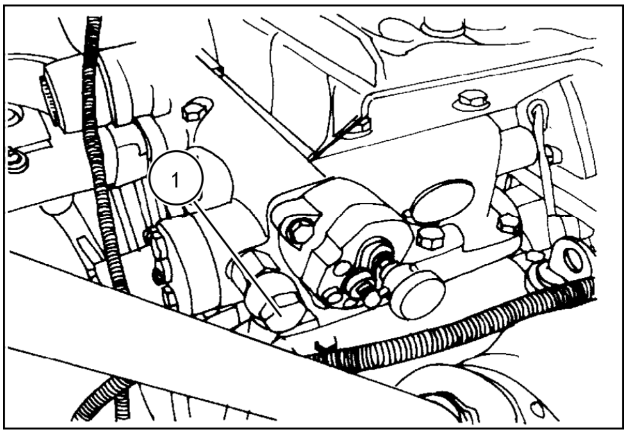
20097820 13

19. Attach the lift rods, **(1)**, to the lift housing.
20. Attach the lower lift links, **(2)**, to the rear axles.



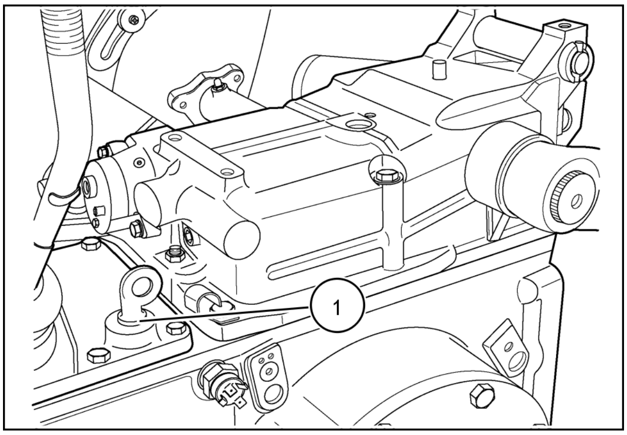
20097823 14

21. Attach the hydraulic line, **(1)**, which connects the pump and hydraulic distributor.



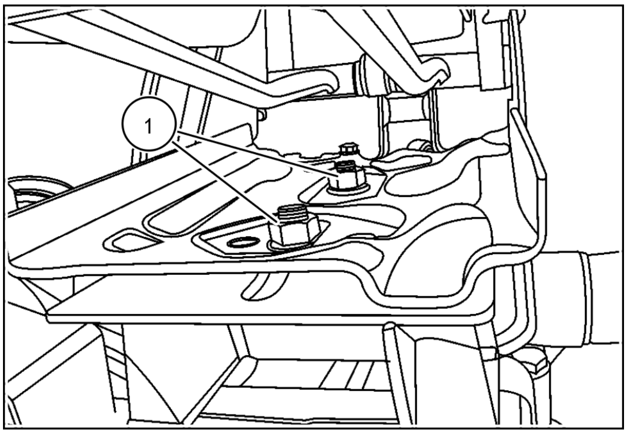
20097480 15

22. Fill the transmission assembly with **NEW HOLLAND AMBRA MULTI G 134** at location **(1)**. Check and fill as required according to the Operator’s Manual.



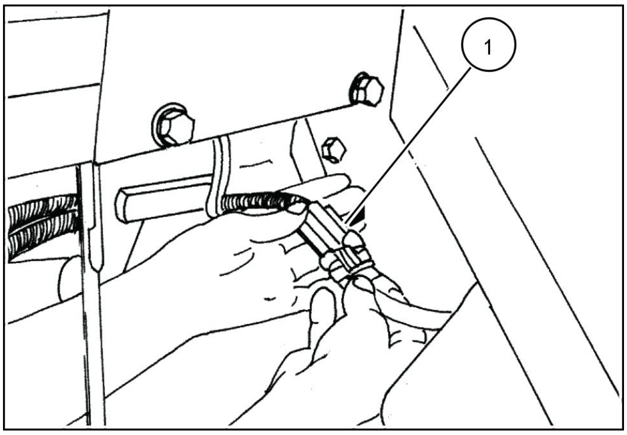
86065628 16

23. Install the operator’s seat onto the hydraulic housing and secure with hardware, **(1)**.



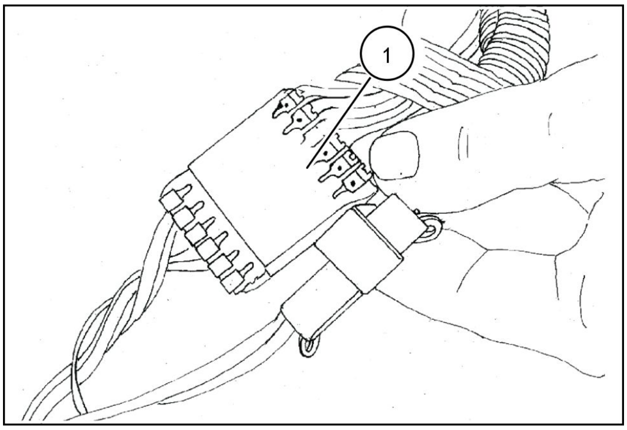
20097825 17

24. Connect the electrical connections, **(1)**, between the left-hand side and right-hand side fenders.



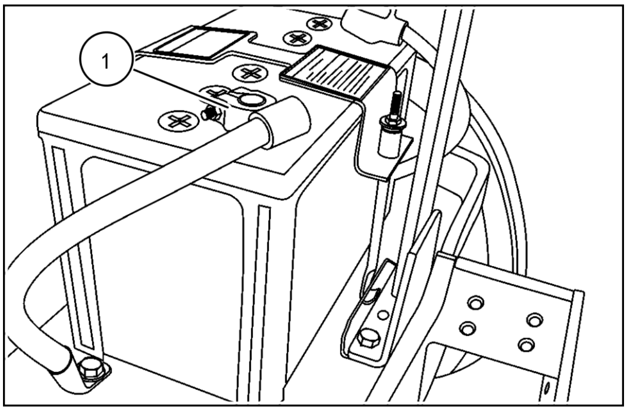
20093437 18

25. Connect the rear electrical connections, **(1)**, under the rear hood console.



20093436A 19

26. Connect the negative battery cable, **(1)**, to the negative battery terminal.



20099930 20

Next operation:
Bevel gear - Backlash Adjustment of bevel drive shaft bearing preload and ring gear/pinion backlash adjustment (D.12.A)

REAR AXLE - Troubleshooting

Problem	Possible Cause	Correction
Noisy rear axle when the tractor is moving and also when transmission in neutral (not originating from final drives)	1. Pinion and/or ring gear bearing misadjustment.	Remove rear axle housing and adjust pinion and ring gear bearings correctly.
	2. Excess differential side gears to halfshaft spline backlash.	Remove rear axle housing and replace damaged parts.
Noisy rear axle with tractor under load and upon release	1. Excess bevel pinion to ring gear backlash.	Remove rear axle housing and adjust bevel pinion and ring gear bearings correctly.
	2. Fault or defective inner components.	Remove rear axle housing, replace worn parts and adjust differential gear backlash correctly.
Noisy rear axle with overheating	1. Insufficient pinion and/or ring gear bearing backlash.	Remove rear axle housing and adjust bevel pinion and ring gear bearings correctly.
	2. Insufficient bevel pinion to ring gear tooth backlash.	Remove rear axle housing and adjust ring gear bearings correctly.

Final drive - Troubleshooting

Problem	Possible Cause	Correction
Noisy final drives when the tractor is moving and also with transmission in neutral	Wheel axle shaft bearing misadjusted.	Remove final drive case and adjust bearings.
	Faulty or defective inner components.	Remove final drive case and replace damaged parts.
	Excess bull and pinion gear backlash.	Remove final drive case and replace damaged parts.

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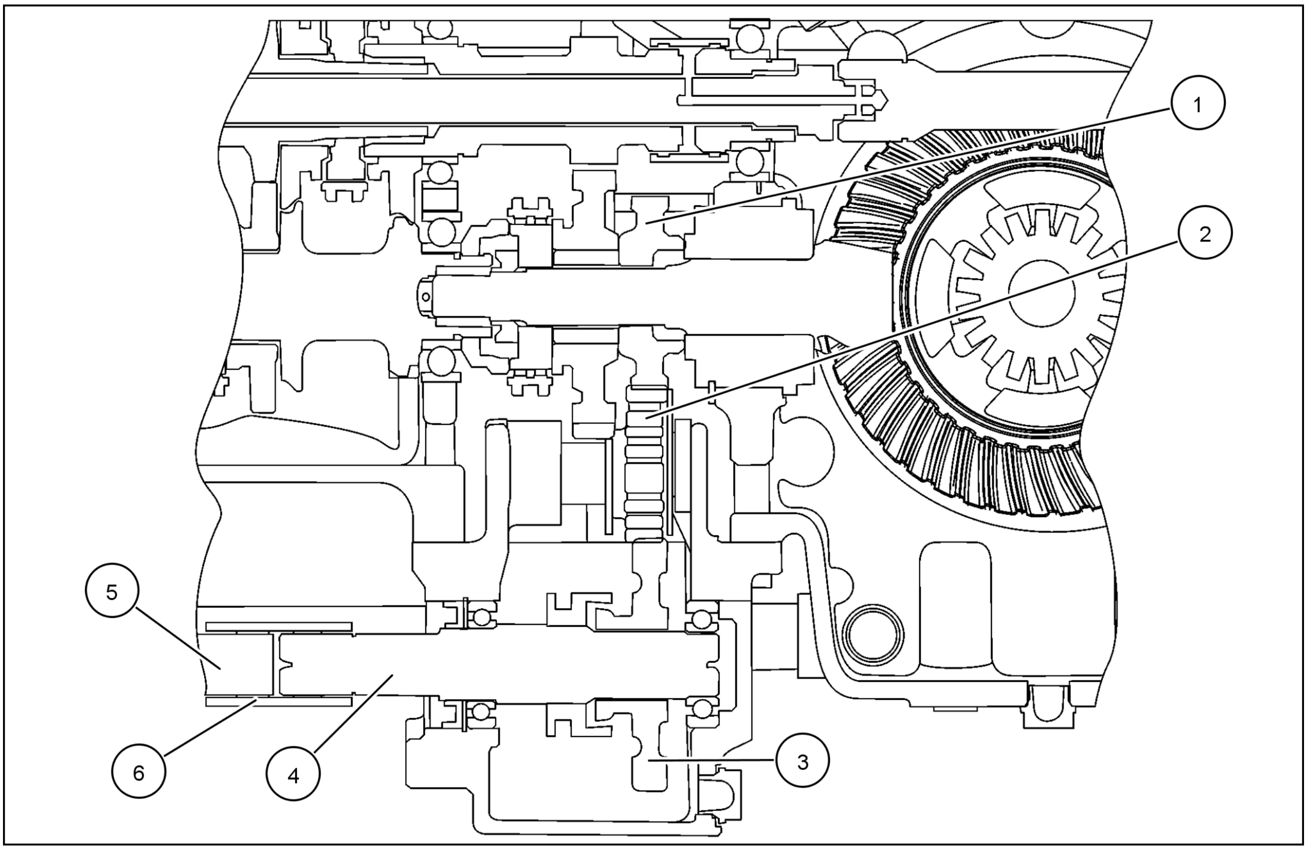
Gearbox - Dynamic description

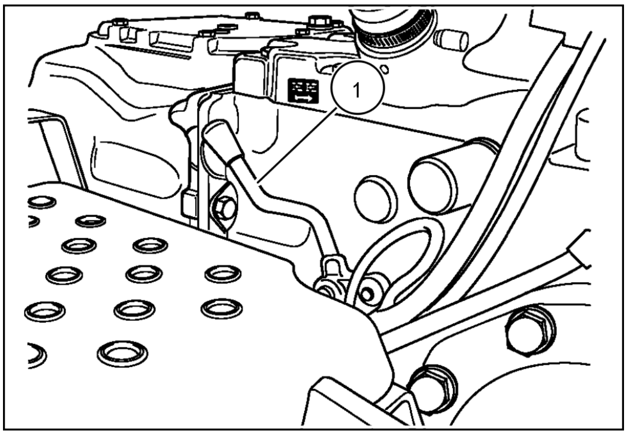


200900129 1

Power is transmitted to the (FWD) transfer box from the 33 tooth drive gear, **(1)**, that is assembled to the rear axle pinion shaft, then to the 27 tooth idler gear, **(2)**. The idler gear transmits power to the 39 tooth output gear, **(3)**, which is mounted on the (FWD) output shaft, **(4)**. When the slider gear is moved forward, the gears are engaged and power is delivered to the (FWD) output shaft. The output shaft is connected to the (FWD) drive shaft, **(5)**, with splined coupler, **(6)**.

FOUR-WHEEL DRIVE LEVER

The four-wheel drive lever, **(1)**, is mounted to the transmission housing on the left side of the operators area.



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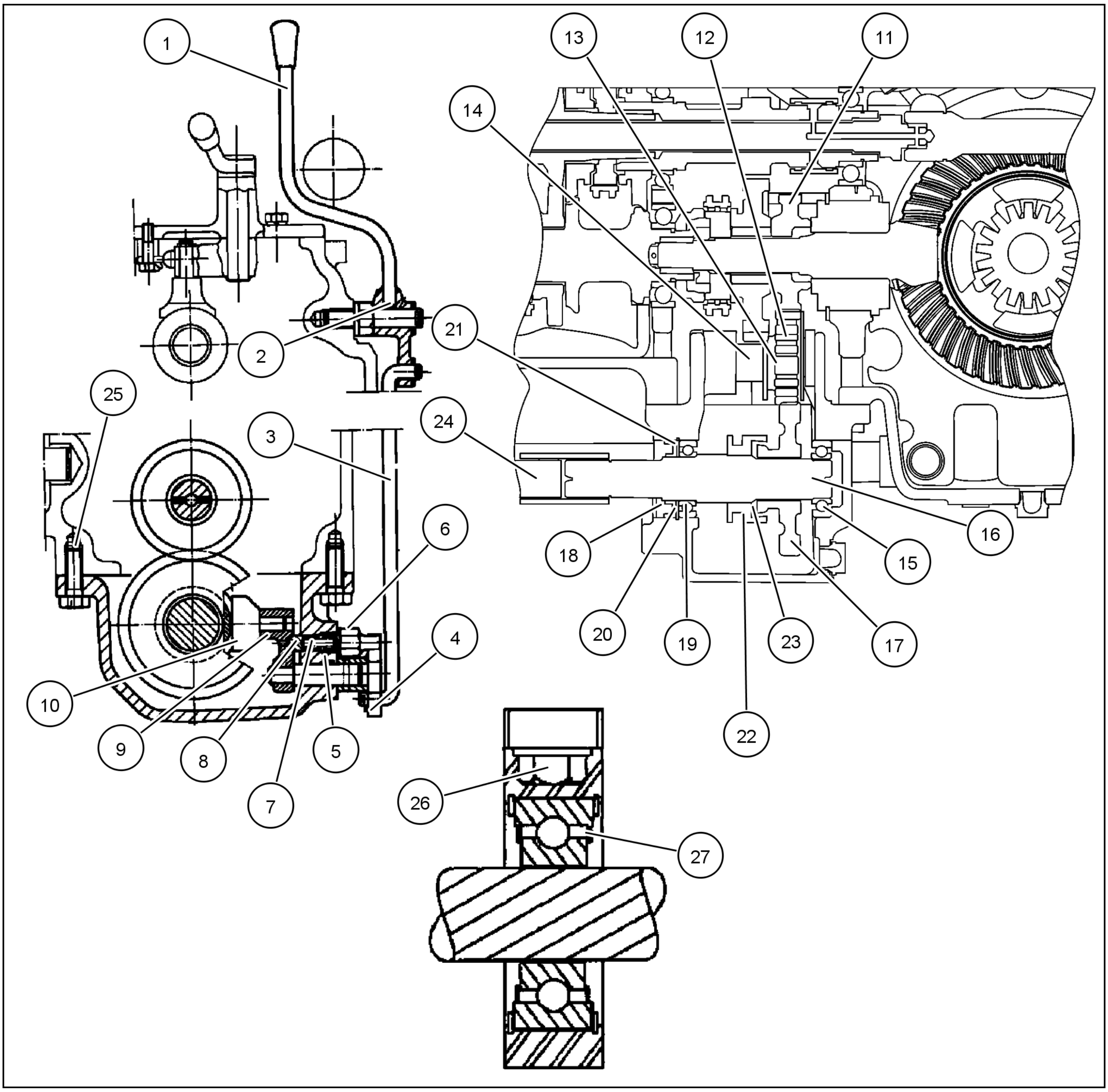


200900130 3

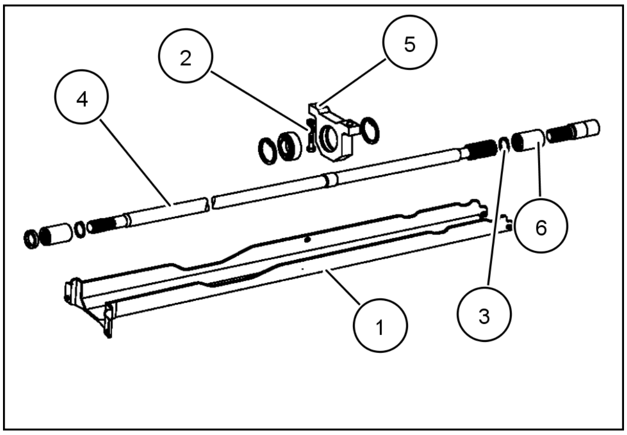
1. FWD Engagement Lever
2. Engagement Lever Pivot Pin
3. Engagement Lever Vertical Rod
4. (FWD) Control Lever
5. O-Ring
6. Plug
7. Detent Plunger Spring
8. Detent Plunger
9. Inner Change Lever
10. Pad
11. Drive Gear (33 tooth) - keyed to pinion gear
12. Intermediate Gear (27 tooth)
13. Bearing
14. Intermediate Shaft
15. Bearing
16. Output shaft
17. Output shaft Gear (39 tooth)
18. Dust Excluder
19. Bearing
20. Retaining Ring
21. Seal
22. Splined Coupler
23. Retaining Ring
24. Drive Shaft
25. Transfer box mounting bolts (7)
26. Drive shaft center bearing support bolts (2)
27. Drive shaft center support with bearing

Drive shaft - Remove

1. Remove drive shaft guard, **(1)**.

NOTE: *The drive shaft guard can be separated into two sections.*

2. Remove the two mounting bolts, **(2)**, from drive shaft center mounting bracket.
3. Unseat retaining ring, **(3)**.
4. Remove drive shaft, **(4)**, complete with the center support, **(5)**, and splined coupler, **(6)**.
5. Inspect splines of shaft, coupler and condition of bore of center support housing for wear or damage.



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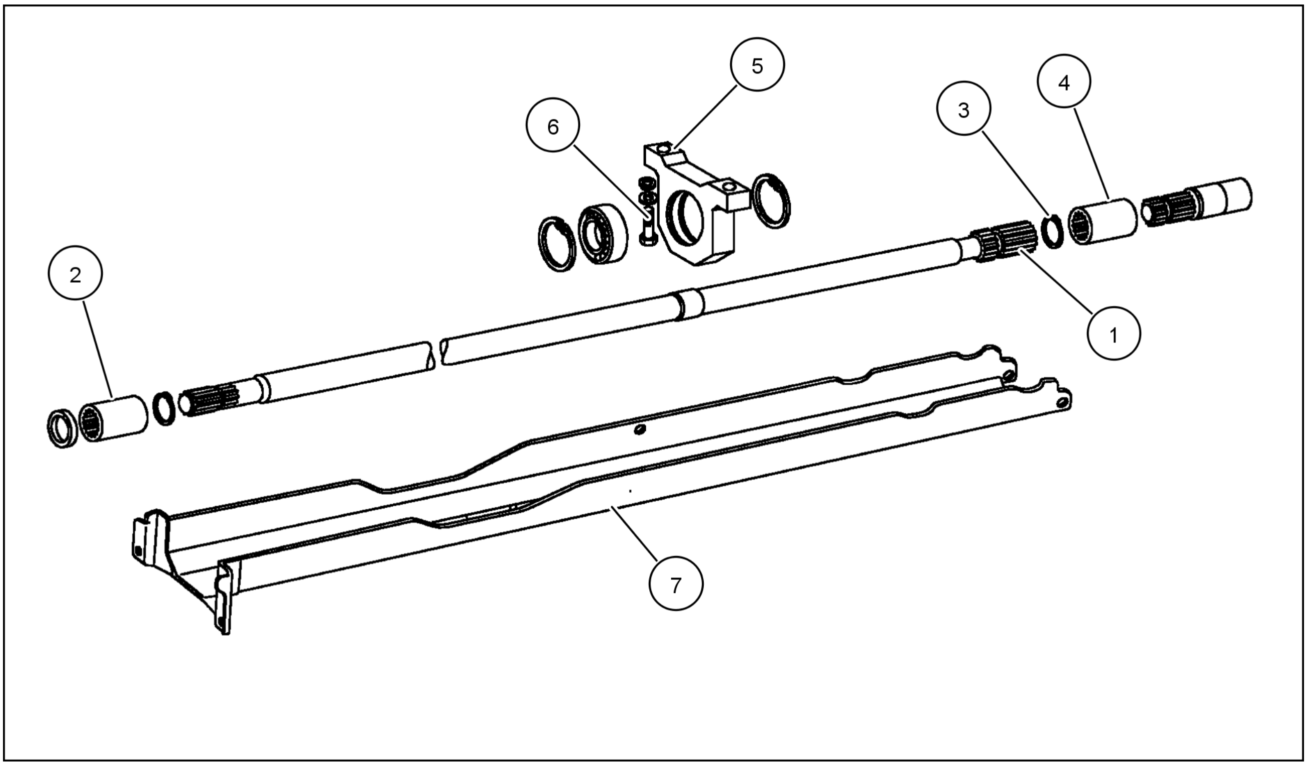
Next operation:
Gearbox - Remove Transfer box (D.14.B)

Drive shaft - Install



20097726 1

1. Install drive shaft, **(1)**, into front axle splined coupler, **(2)**, first.
2. With retaining ring, **(3)**, not seated install drive with rear splined coupler, **(4)**, onto transfer box output shaft. Seat retaining ring into groove in shaft after drive shaft is installed in rear coupler.
3. Install center drive shaft mounting bracket, **(5)**, onto the tractor using two M16 x 45 bolts, **(6)**.
4. Torque mounting bolts to **245 N·m** (**181 lb ft**)
5. Reinstall the drive shaft guard, **(7)**, using the M8x14 bolts that were removed previously. Then torque bolts to **30 N·m** (**22 lb ft**)

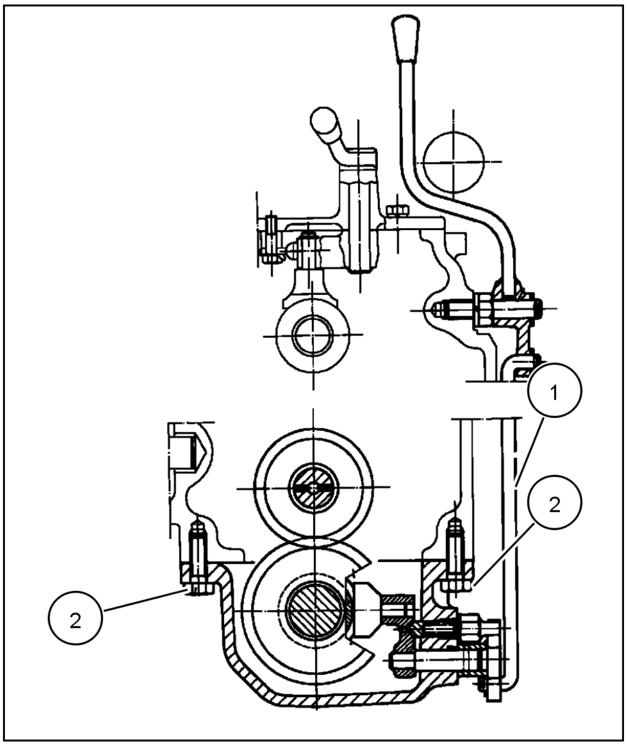
NOTE: *The drive shaft guard can be separated into two sections.*

Gearbox - Remove Transfer box

Prior operation:
Drive shaft - Remove (D.14.B)

1. After removing the drive shaft, drain the oil from the tractor transmission.
2. Detach the hand lever vertical rod, **(1)**, from the transfer box control lever.
3. Remove the mounting bolts, **(2)**, and remove transfer box as an assembly.

NOTE: *Drain the oil from the transfer box by removing the drain plug on the transfer box.*



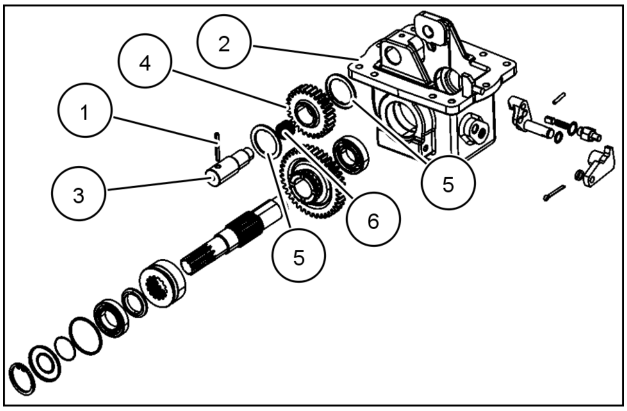
20097721 1

Next operation:
Gearbox - Disassemble Transfer box (D.14.B)

Gearbox - Disassemble Transfer box

Prior operation:
Gearbox - Remove Transfer box (D.14.B)

1. Use a punch to remove the roll pin, **(1)**, from the transfer box, **(2)**, and idler gear shaft, **(3)**.
2. Push the idler gear shaft, **(3)**, forward out of the transfer box, **(2)**, and remove the idler gear, **(4)**, spacers, **(5)**, and needle bearing, **(6)**, from the transfer box.
3. Check the idler gear shaft, idler gear, spacers, and needle bearing for any wear or damage. Replace as necessary.

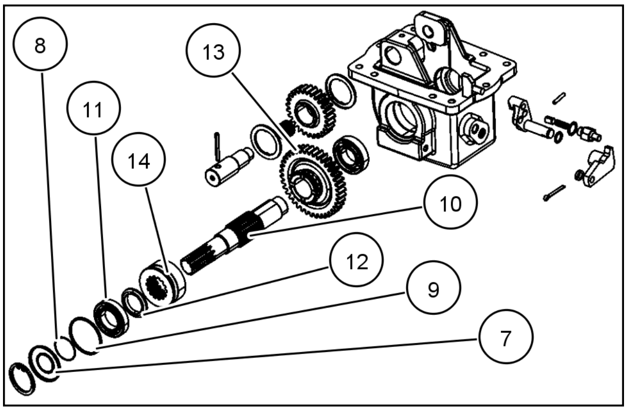


200900126 1

4. Remove the following:
   - Dust Seal Disc - **(7)**.
   - Shaft Seal - **(8)**.
   - Retaining Ring - **(9)**.
   - Output shaft - **(10)**, with bearing - **(11)**, and dust excluder, **(12)**.

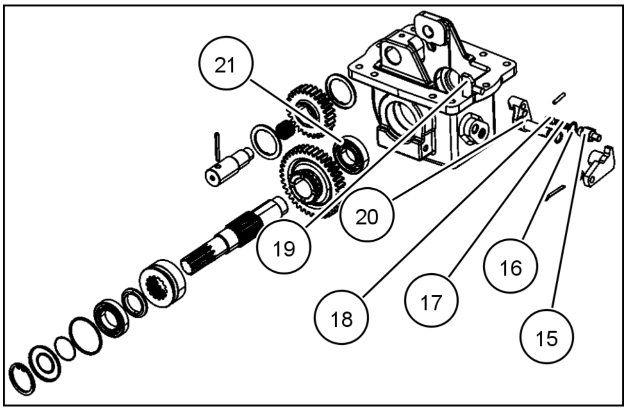
NOTE: *Drill a 1/8 inch hole on each side of the dust seal,* ***(7)****, and shaft seal,* ***(8)****, and insert sheet metal screws into the holes to pull the parts from the case bore.*

5. Remove the output shaft gear, **(13)**, and splined coupler, **(14)**, from the case.



200900126 2

6. To remove shift lever:
   - Unscrew the plug, **(15)**, with sealing washer, **(16)**.
   - Remove Detent Plunger Spring, **(17)**.
   - Remove Detent Plunger, **(18)**.
   - Remove Pad, **(19)**.
   - Remove Inner change lever, **(20)**, from case.
7. To remove rear bearing, **(21)** use a slide hammer puller.

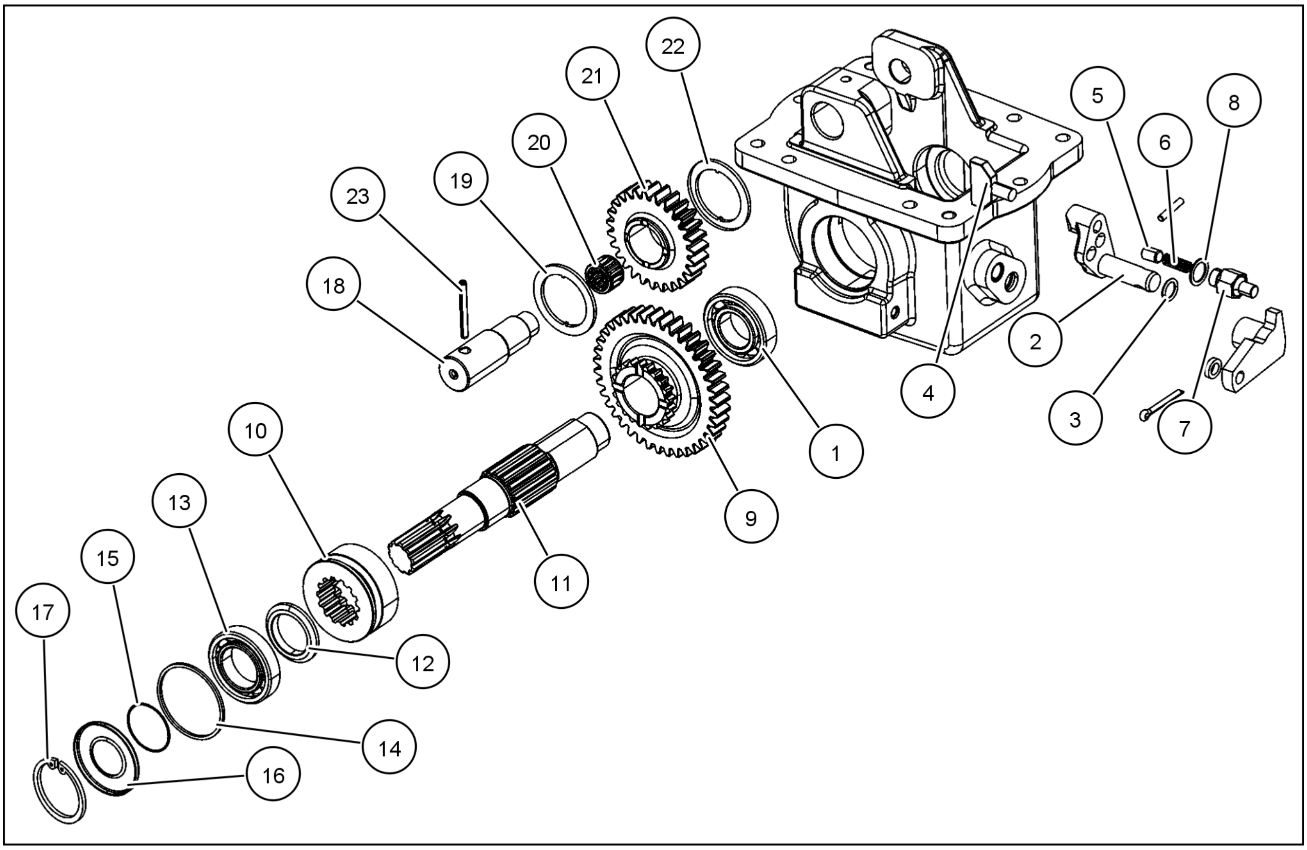


200900126 3

Next operation:
Gearbox - Assemble Transfer box (D.14.B)

Gearbox - Assemble Transfer box

Prior operation:
Gearbox - Disassemble Transfer box (D.14.B)



200900125 1

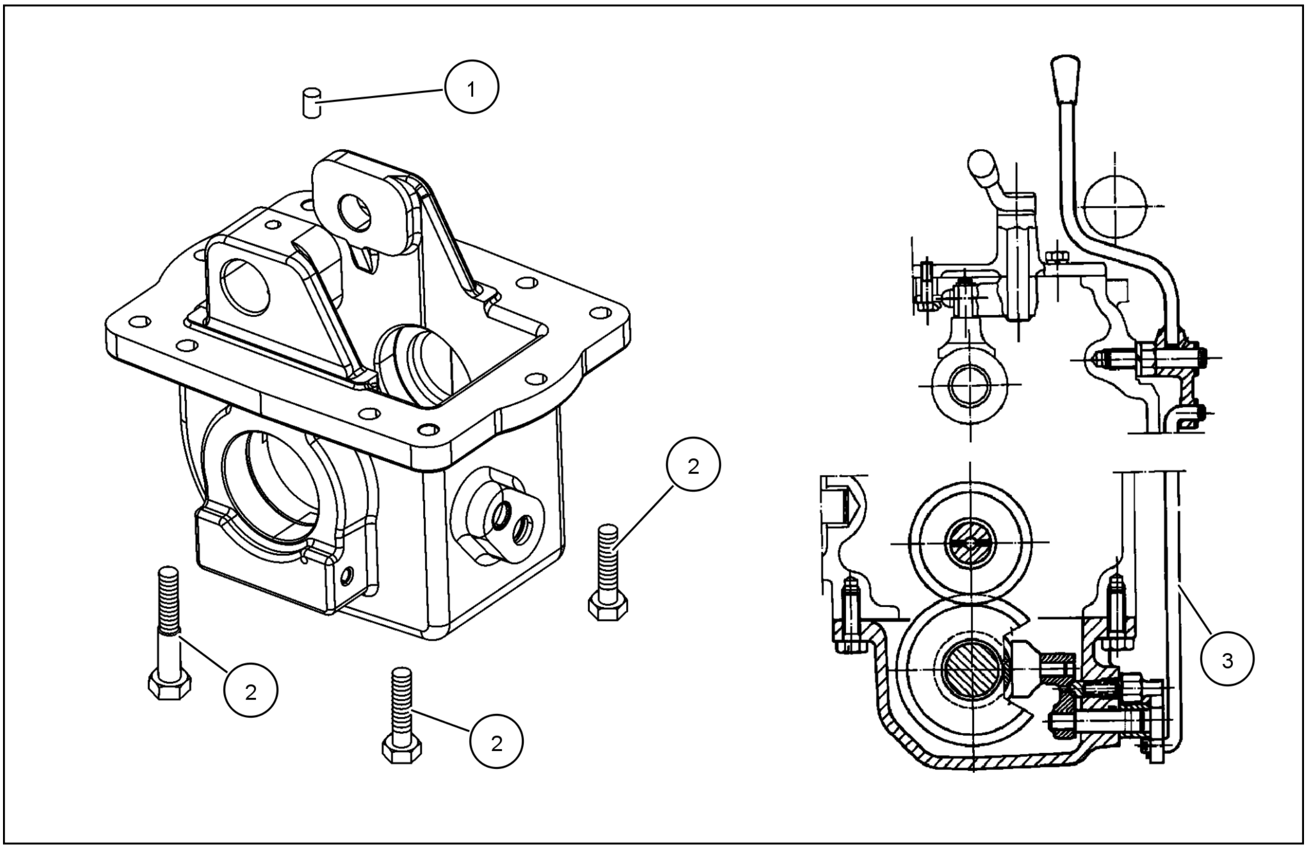
1. Install rear bearing, **(1)**, into transfer box.
2. Install inner change lever, **(2)**, with O-ring, **(3)**, into transfer box.
3. Install pad, **(4)**, onto the change lever.
4. Install detent plunger, **(5)**, plunger spring, **(6)**, plug, **(7)**, with sealing washer, **(8)**.
5. Place output shaft gear, **(9)**, and splined coupler, **(10)**, into the transfer box.
6. Slide output shaft, **(11)**, through the coupler, gear and into the rear bearing. Seat shaft fully into rear bearing.
7. Install, dust excluder, **(12)**, front bearing, **(13)**, onto the output shaft.
8. Install retaining ring, **(14)**, into the groove in the transfer box.
9. Install shaft seal, **(15)**, and dust seal disc, **(16)**, into the transfer box.
10. Install retaining ring, **(17)**, onto the output shaft.
11. Slide the idler gear shaft, **(18)**, into the front of the transfer box and slide the spacer, **(19)**, needle bearing, **(20)**, idler gear, **(21)**, and spacer, **(22)**, onto the shaft.

12. Secure the idler gear shaft, **(18)**, by using a punch to drive the roll pin, **(23)**, into the shaft and transfer box.

Next operation:
Gearbox - Install Transfer box (D.14.B)

Gearbox - Install Transfer box

Prior operation:
Gearbox - Assemble Transfer box (D.14.B)



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1. Make sure that the two locating dowel pins, **(1)**, are installed in the transfer box.
2. Place a bead of gasket eliminator 518 onto the mounting surface of the transfer box.
3. Install transfer box assembly onto the tractor using eight M10 x 30, **(2)**, mounting bolts.
4. Torque bolts to **49 - 62.8 N·m** (**36.1 - 46.3 lb ft**)
5. Attach the vertical hand lever rod, **(3)**, onto the transfer box lever.
6. Refill transmission with oil.

Next operation:
Drive shaft - Install (D.14.B)

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AXLES, BRAKES AND STEERING - D

STEERING Hydraulic - 20.C

Workmaster 45
Workmaster 55

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STEERING Hydraulic - General specification

Type	Hydrostatic
Make	DANFOSS
Hydraulic circuit	Independent, separate pump
Oil reservoir	Transparent plastic on right-hand side of engine
Oil filter	in oil reservoir, gauze
Hydraulic Pump	
Type	Gear
Make	ISM
Drive	From engine
Max. Pump Flow	**19.4 l/min** (**5.12 US gpm**)
Control Valve	DANFOSS
Type	with steering column operated rotary valve (permitting steering also in case of pump failure)
Outfit code: - DANFOSS (with valves in control valve)	OSPC 70
Relief valve setting	**10300 kPa** (**1494 psi**)
Power Cylinder:	
Type	Double acting, located behind front axle
Make	OGNIBENE
Cylinder bore diameter	**48 mm** (**1.89 in**)
Piston rod diameter	**22 mm** (**0.866 in**)
Maximum piston stroke with cylinder make:	182

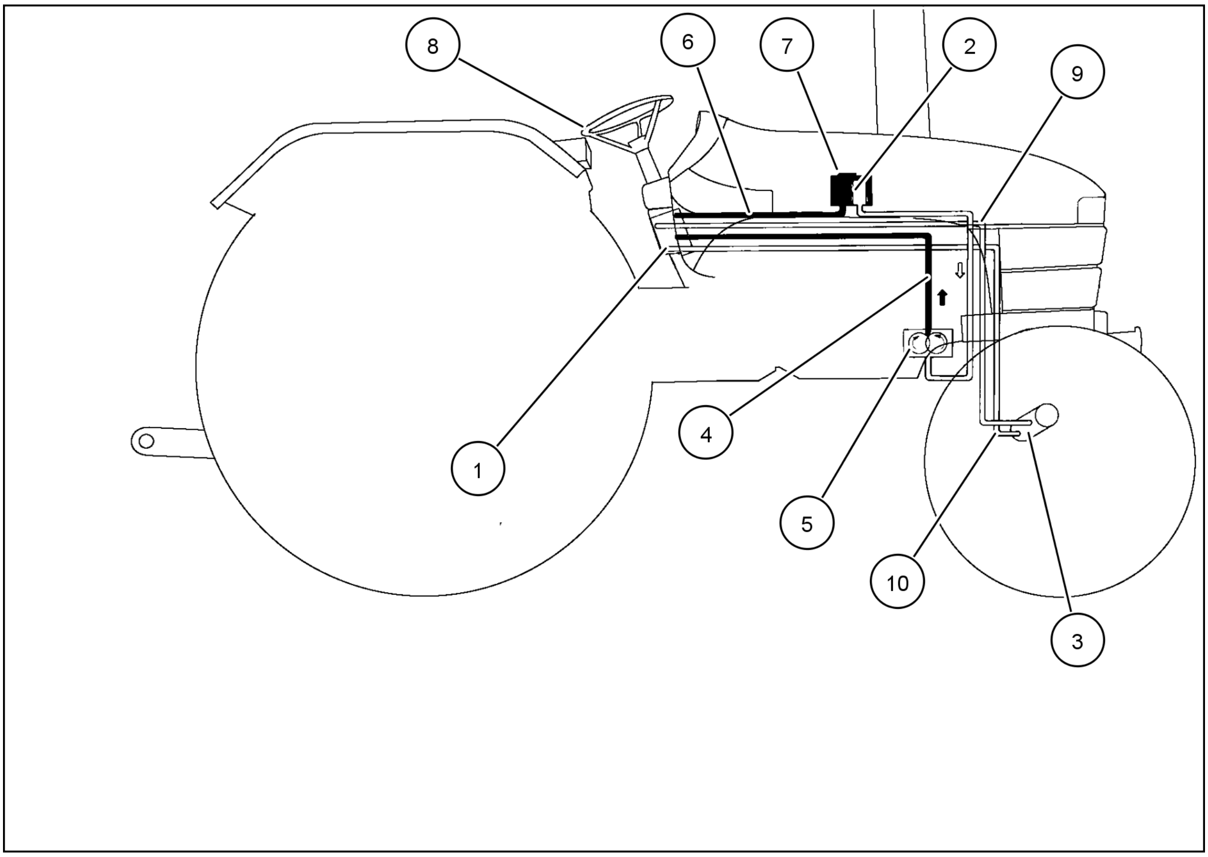
STEERING Hydraulic - Torque

Description	Thread Size (mm)	Torque N.m (lb ft)
Capscrew, control valve support **(1)**	M16 x 1.5	**150 N·m** (**111 lb ft**)
Capscrew, control valve to tractor **(2)**	3/8″-16 UNC	**45 N·m** (**33 lb ft**)
Capscrew, control valve to valve **(3)**	M8 x 1	**35 N·m** (**26 lb ft**)
Nut, power cylinder pivot pin **(4)**	M18 x 1.5	**300 N·m** (**221 lb ft**)
Nut, power cylinder piston rod to steering arm **(5)**	M16 x 1.5	**210 N·m** (**155 lb ft**)
Nut, piston to rod **(6)**	M16 x 1.5	**100 N·m** (**74 lb ft**)
Capscrew, steering pump to engine **(7)**	M12 x 1.25	**8 N·m** (**6 lb ft**)
Nut, cover to pump body **(5)**	M6 x 1	**50 N·m** (**37 lb ft**)
Nut, drive sleeve to pump drive shaft **(5)**	7/16″-20 UNF-2B	**28 N·m** (**21 lb ft**)

STEERING Hydraulic - Special tools

Tool Description	Tool No.
Steering Wheel Puller	380003008
Adapter, Power Steering Pressure Check (included in the set of Hydraulic pressure kit **380000240**)	**380000613**
Installer, Power Steering Rotor Spring	**380000549**
Adapter, Power Steering Pressure Check Fitting	380002744

STEERING Hydraulic - Dynamic description



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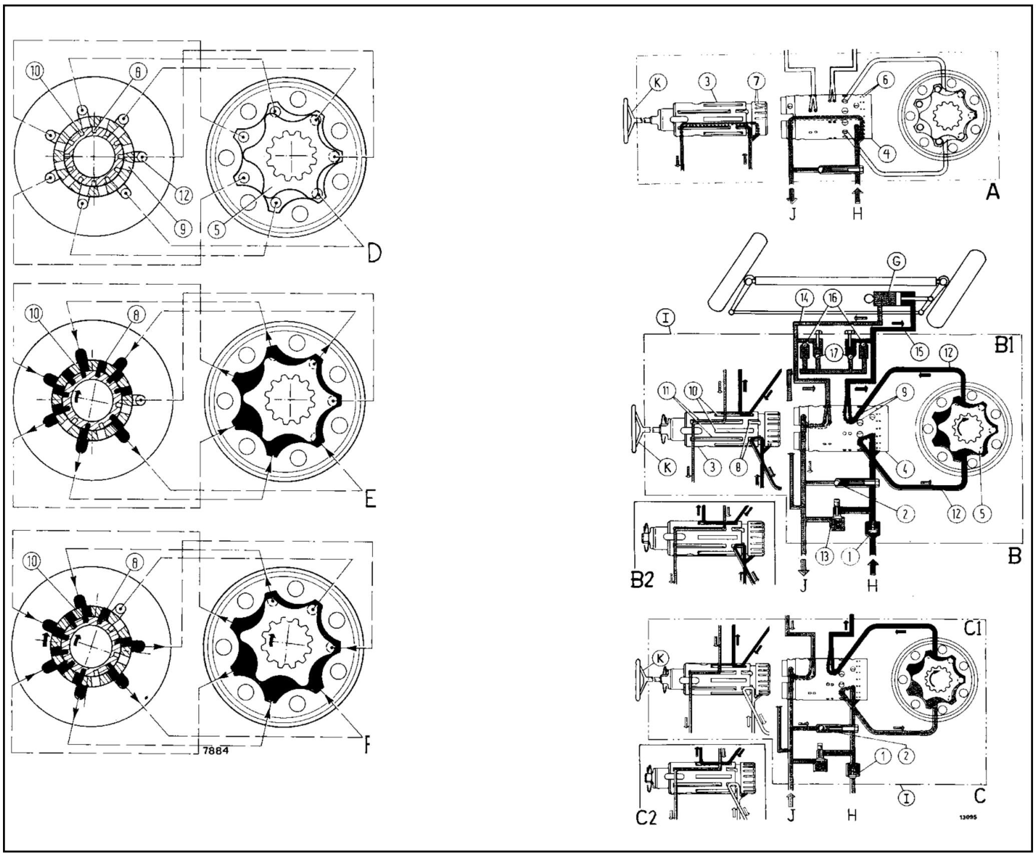
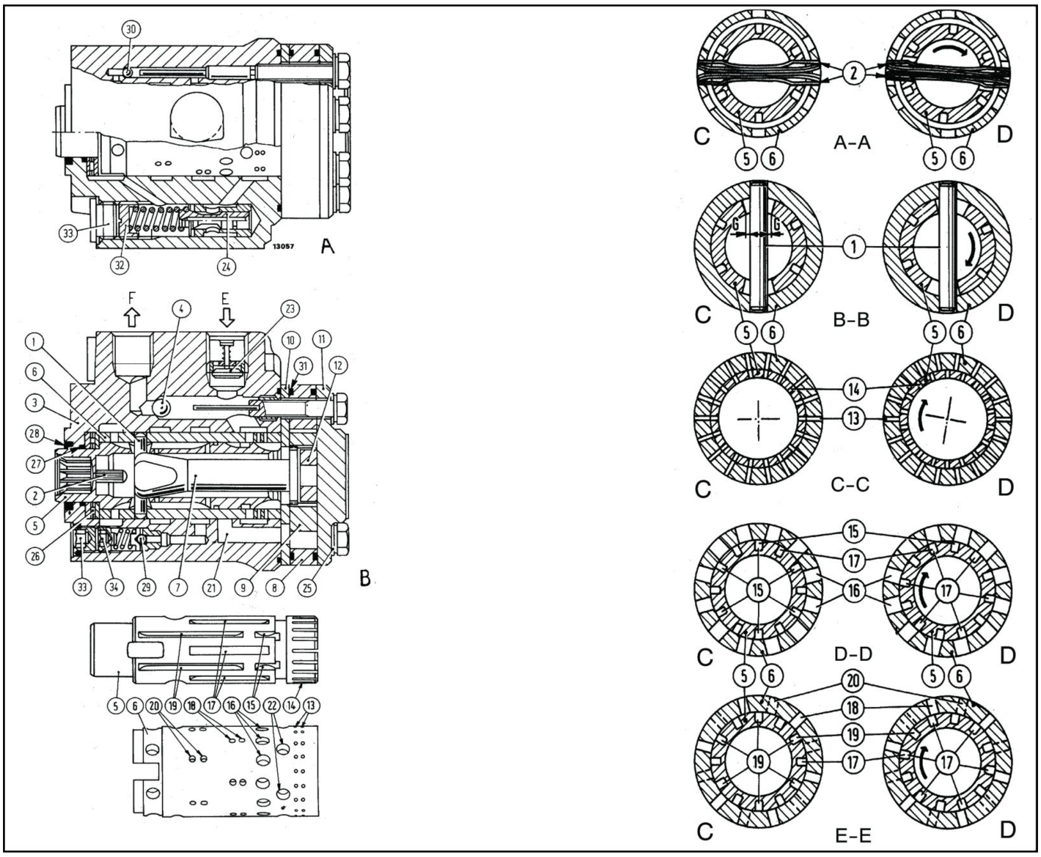
1. Control valve
2. Filter cartage
3. Power cylinder
4. Pump outlet line
5. Hydraulic pump
6. Return to tank
7. Reservoir
8. Steering wheel
9. Oil passage to left-hand power cylinder chamber
10. Oil passage to right-hand cylinder chamber, piston rod side



20097644 2

A. Operation in straight-ahead driving position
B. Right-hand. **(B1)** and left-hand. **(B2)** steer
C. Right-hand. and left-hand **(C2)**
D. Operation diagram for straight-ahead driving
E. Operation diagram for two-stage left-hand steering
F. Operation diagram for two-stage right-hand steering
G. Power cylinder
H. Pump outlet line
I. Control valve
J. Return to tank
K. Steering wheel
1. Check valve
2. Check valve
3. Rotary valve
4. Valve seat sleeve
5. Rotor
6. Oil Port
7. Oil Port
8. Rotor inlet passages (6 off)
9. Connecting port (12 off) communicating with passages **(8)** and **(10)** alternatively
10. Pressure passages (6 off) to power cylinder communicating with the rotor recesses and ports **(18)** and **(20)**, Figure **3**
11. Power cylinder exhaust passages (6 off) communicating with ports **(18)** and **(20)**, Figure **3**
12. Oil passages from port **(16)** to rotor recesses
13. Relief valve
14. Oil passage to left-hand. power cylinder chamber
15. Oil passage to right-hand. cylinder chamber, piston rod side
16. Cylinder safety valves
17. Make-up valves



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A. Cross section view of Danfoss OSPC 70 control valve
B. Cross section view of Danfoss OSPC 70 control valve
C. Section through control unit with valve, **(5)**, in neutral
D. Sections through control unit with valve, **(5)**, in right-hand steer position (for left-hand. steer, valve position is symmetrical in opposite direction)
E. Pump outlet line
F. Return to tank
G. Gap between pin, **(1)**, and rotary valve **(5)**
1. Drive pin
2. Sleeve return springs
3. Control valve body
4. Check valve
5. Rotary valve
6. Valve seat sleeve
7. Rotor drive shaft
8. Rotor cam ring
9. Rotor
10. Thrust ring
11. Cover
12. Spacer
13. Oil ports
14. Oil ports
15. Rotor inlet passages (6 off)
16. Connecting port (12 off) communicating with passages **(15)** and **(17)** alternatively
17. Pressure passages (6 off) to power cylinder communicating with the rotor recesses and ports **(18)** and **(20)**
18. Right-Hand power cylinder chamber outlet or exhaust ports (6 pairs)
19. Power cylinder exhaust passages (6 off) communicating with ports **(18)** and **(20)**
20. Left-hand power cylinder chamber outlet or exhaust ports (6 off)
21. Oil passage from ports **(16)** to rotor recesses
22. Supply ports for passages **(15)**
23. Check valve
24. Relief valve
25. Washer
26. Thrust bearing
27. Seals
28. Dust excluder
29. Cylinder safety valves
30. Make-up valves
31. O-rings
32. Valve adjusting screw
33. Plugs
34. Valve adjusting screw

Hydrostatic steering system is powered (when the engine is running) by steering pump mounted on the front side of the engine timing gear.
Hydrostatic steering system incorporate a steering pump, **(5)**, Figure **1**pressurizes the steering column operated control valve, **(1)**, Figure **1** The pressurized oil from the control valve operates the axle mounted double acting steering cylinder, **(3)**, Figure **1**
The control valve is bolted to a bracket mounted on transmission housing and connected to the steering column by a spindle shaft.
The steering cylinder is fixed at one end to the front axle beam and at the other to an eye on the spindle arm.
The pressure relief value for the system is contained within the steering control valve itself.

OPERATION

Oil is drawn from the reservoir, **(7)**, Figure **1** , and into the pump through a filter, **(2)**, Figure **1** pressurized by the rotation of the gears and expelled through the pump outlet port to the steering control valve. The pressurized oil when received at the control valve is directed to the steering actuating cylinder when the steering wheel is turned.
The control valve incorporates a metering unit which regulates the volume of oil supplied to the cylinder so that it is proportional to the angular movement of the steering wheel. The metering unit in combination with the check valve also allows the steering to be operated manually without pressurized oil being supplied from the pump.
The system is fully hydrostatic and as such there is no mechanical connection between the steering column and the steering wheels.

Straight-ahead Driving (A, a, d)

With steering wheel, **(K)** Figure **2** stationary, rotary valve, **(5)**, Figure **3** takes neutral position relative to sleeve, **(6)**, Figure **3**.This position is maintained through the action of springs, **(2)**, Figure **3**, Section A-A, and the following conditions exist:

- Pin, **(1)**, Figure **3**, Section B-B, is central in the valve, **(5)**, Figure **3**, aperture.
- Ports, **(13)** and **(14)** Figure **3**, are in alignment, (Section C-C) and the oil pressure from pump, **(5)** Figure **1**, is returned to tank.
- Passages, **(15)**, **(17)** and **(19)** Figure **3**, on the valve (Sections D-D and E-E) are off register relative to ports, **(16)**, **(18)** and **(20)**, on the sleeve (i.e. all ports in communication with the power cylinder remain closed).

RH Steer (B, Sd, b, e, f)

Upon turning steering wheel, **(K)** Figure **2**, clockwise, springs, **(2)** Figure **3**, Section A-A, deflect allowing valve, **(5)** Figure **3**, to rotate relative to sleeve, **(6)** Figure **3**, until gap, **(G)**, section B-B, is taken up.

Thus:

- Ports, **(13)** and **(14)** Figure **3**, Section C-C, go out of alignment to discontinue oil return.
- Six passages, **(15)** Figure **3**, Section D-D, line up with an equal number of ports, **(16)** Figure **3**, connected instant by instant with the rotor recesses during the inlet phase.
- Six pressure passages, **(17)** Figure **3**, Section E-E, line up with ports, **(18)** Figure **3**, communicating with the power cylinder. Moreover, the oil pressure passages communicate with the remaining ports, **(16)** Figure **3**, Section D-D, connected instant by instant with the rotor recesses during the actuation phase.
- Six exhaust passages, **(19)** Figure **3**, line up with ports, **(20)** Figure **3**, Section E-E, communicating with the power cylinder.

Once the gap, **(G)**, is eliminated valve, **(5)** Figure **3**, positively transmits steering wheel input to both sleeve, **(6)** Figure **3**, and rotor, **(9)** Figure **3**, through pin, **(1)** Figure **3**, and shaft, **(7)** Figure **3**. Diagrams (E and F, Figure **1** show the principle of operation at start of right-hand steer and after a certain amount of wheel rotation.

The flow of oil pressure from pump to rotor during inlet, and from rotor to power cylinder line during the power actuation phase, is provided instant by instant.

Left-Hand Steer (B, Ss)

Upon turning the steering wheel counter - clockwise, a reversal of the above sequence is obtained and delivery passages, **(17)** Figure **3**, Section E-E, supply ports, **(20)** Figure **3**, to bring about left-hand steering.

Emergency Hydraulic Steer (C, Sed, Ses)

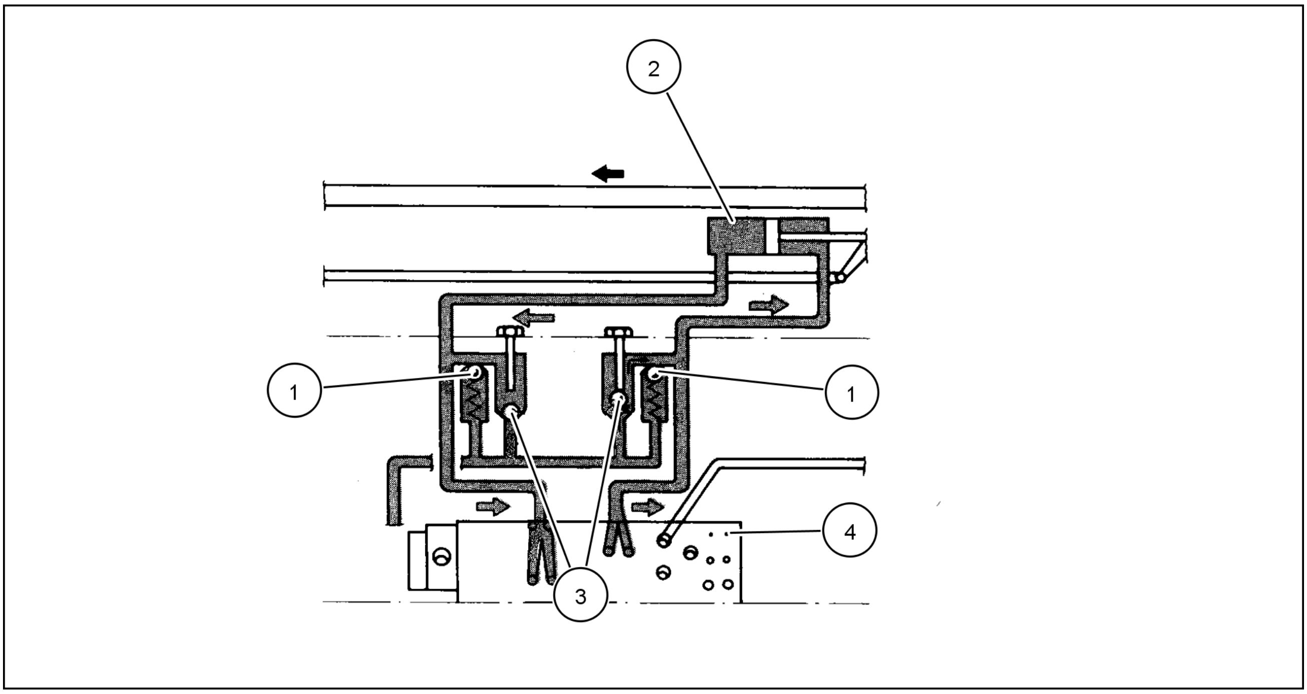
Steering is possible even in cases of loss of hydraulic pressure. Upon turning the steering wheel, valve, **(5)** Figure **3**, takes up the normal operating position, while the rotor functions as a hand pump directing oil pressure to the power cylinder.

Check valve, **(4)** Figure **3**, opens, thereby permitting the flow of oil from tank to rotor by-passing the pump. Valve, **(23)** Figure **3**, remains closed preventing leakage in connecting line between pump and control unit.

Power Cylinder Safety and Make-up Valves

As the safety valves open, **(1)**, pressure created by piston, **(2)**, is exhausted in one cylinder chamber under the action of strong external stress on wheels. Simultaneously, vacuum in the opposite chamber is compensated by oil flow through the opening of the associated make up valve, **(3)**. Pressure in one cylinder chamber deriving from small external stress which are not sufficient to open cylinder safety valve, is exhausted through normal leakage past control valve, **(4)**, while vacuum in the opposite chamber is compensated through make-up, **(3)**, as shown in detail, below, for DANFOSS OSPC 70 control valve.

Operation of the above valves eliminates continuous steering wheel correction and prevents front wheel shimmy, hydraulic circuit failure and damage to the steering linkage.



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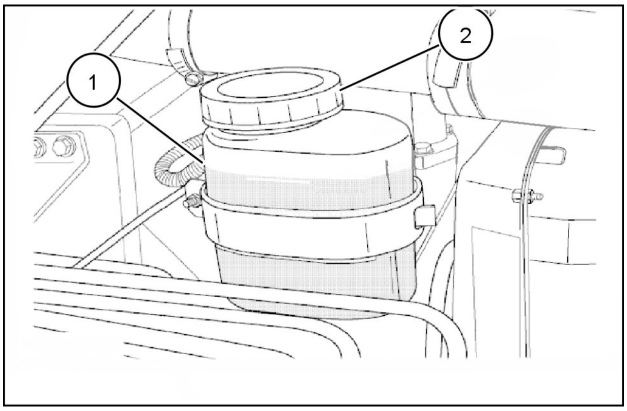
Reservoir - Static description Hydrostatic steering reservoir

The steering system controls the direction of the front wheel assemblies with pressurized hydraulic oil. There is no mechanical linkage connecting the steering column to the wheels, thereby making the steering system hydrostatic.

The steering system includes the following components:

- Reservoir Tank with Filter
- Steering Pump
- Hoses and Tubes
- Steering Motor
- Check Valve
- Pressure Relief Valve
- Steering Cylinder

The reservoir tank, **(1)**, located on the upper right-hand side of the engine, stores hydraulic oil for the steering system. An opening on top of the tank, covered by a large plastic cap, **(2)**, provides a provision for replenishing oil as needed. In addition, the reservoir contains an integral metal cartridge type filter to remove contaminates from the oil.



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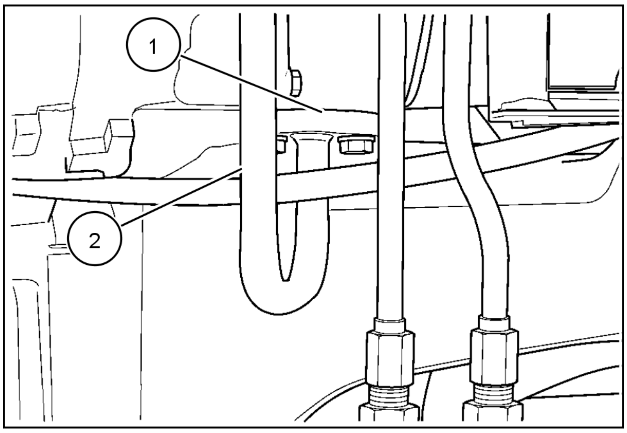
The reservoir tank mounts higher than the steering pump, which allows gravity fed oil to enter the suction port, **(1)**, of the pump through the supply tube, **(2)**. This configuration reduces pump wear by preventing cavitation at first start up.



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Control valve - Remove Steering Motor

1. Position the tractor on a hard level surface and apply the parking brake.

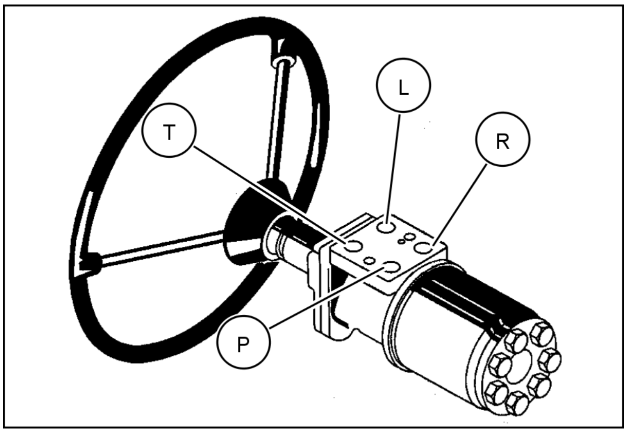
⚠ WARNING ⚠

Handle all parts carefully. Do not put your hands or fingers between parts. Always wear suitable safety items such as fitted clothing, safety goggles, gloves, shoes, etc. Failure to comply could result in death or serious injury.

M954A

2. To gain access to the Steering motor:
   - Remove tractor hood, instrument panel, dash, and rear hood panels.
3. Disconnect the supply/return tubes from the steering motor and cap the ends of the tubes and steering motor to prevent entry of foreign particles.

   T - To Tank
   P - From Pump
   L - Left Port
   R - Right Port



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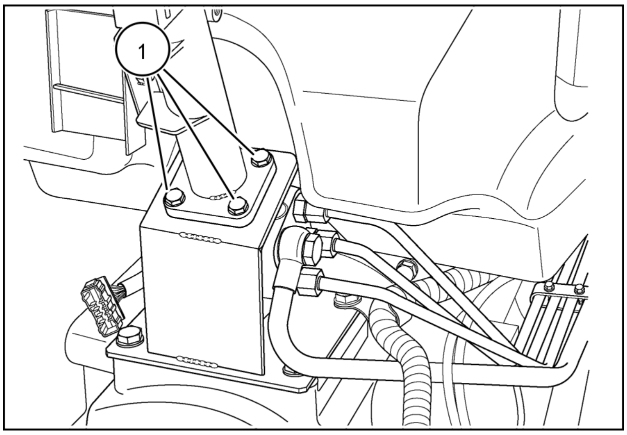
4. Remove the bolts, **(1)**, at the base of the steering column and slide out the steering motor from the steering column.



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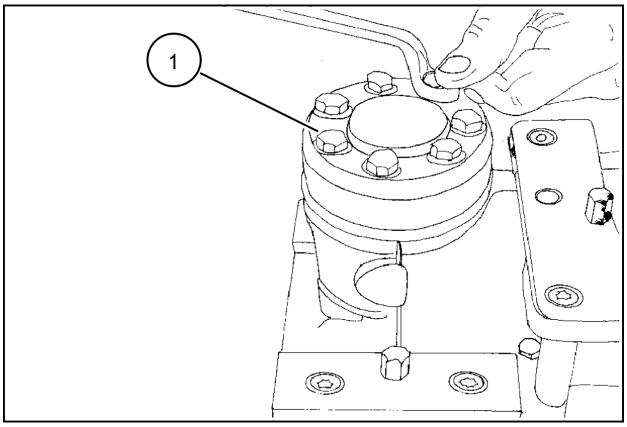
Next operation:
Control valve - Disassemble Steering Motor (D.20.C)

Control valve - Disassemble Steering Motor

Prior operation:
Control valve - Remove Steering Motor (D.20.C)

1. Hold the steering motor securely in a vice.
2. Remove the end cover bolts, **(1)**, (6 plus one special screw).



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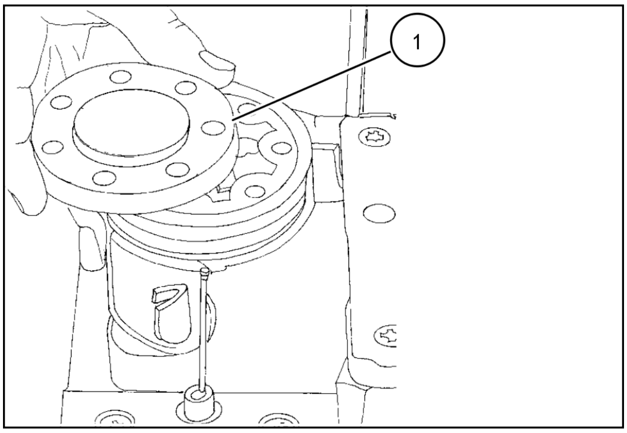
3. Remove the end cover, sideways, **(1)**.



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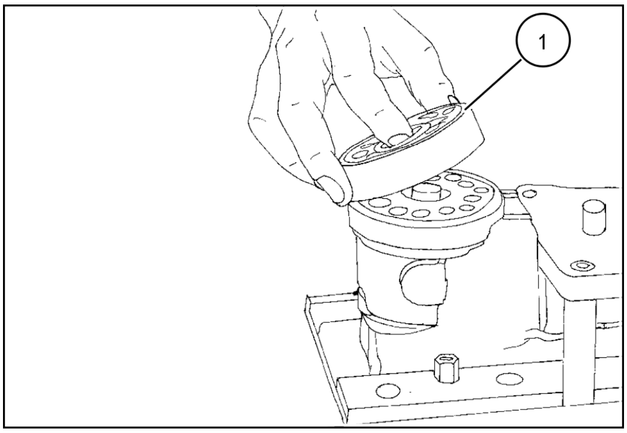
4. Lift the gear wheel set, **(1)**, (with spacer fitted) off the unit. Take out the O-rings.



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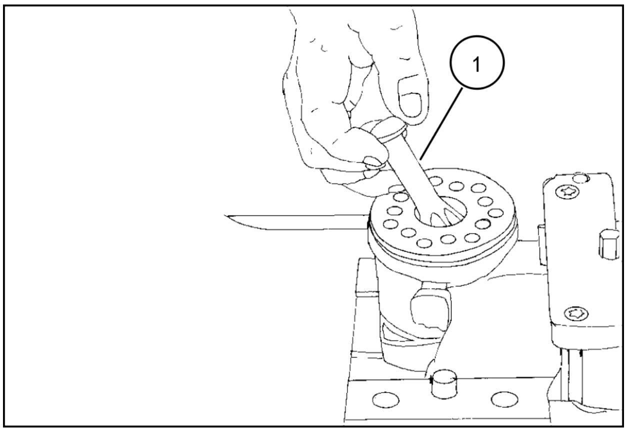
5. Remove cardan shaft, **(1)**.



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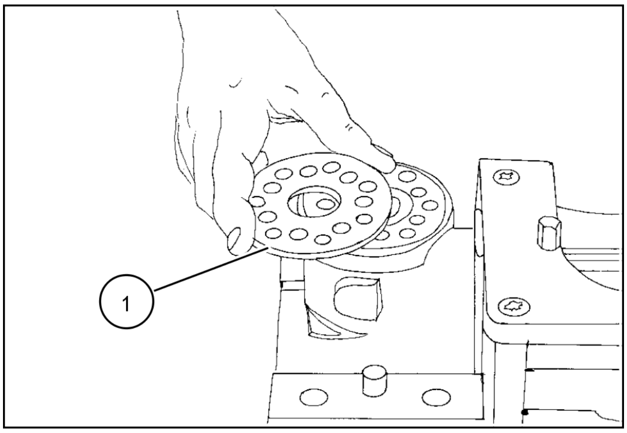
6. Remove distributor plate, **(1)**.



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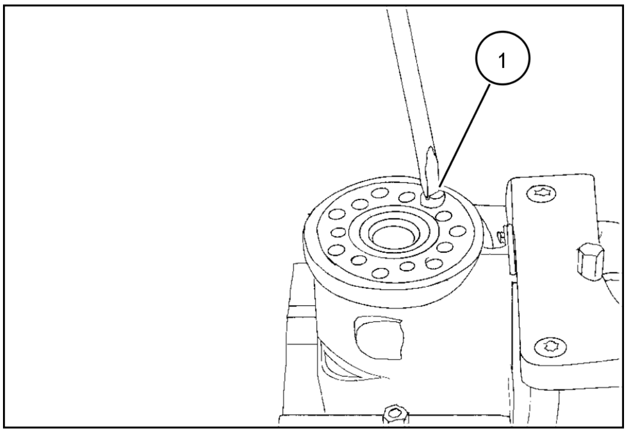
7. Screw out the threaded bushing, **(1)**, over the check valve.



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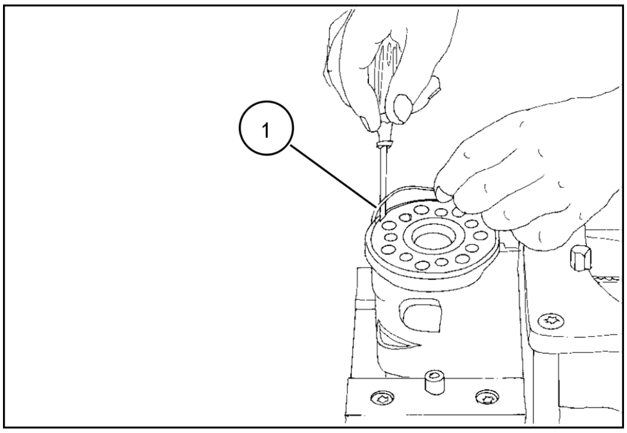
8. Remove O-ring, **(1)**.



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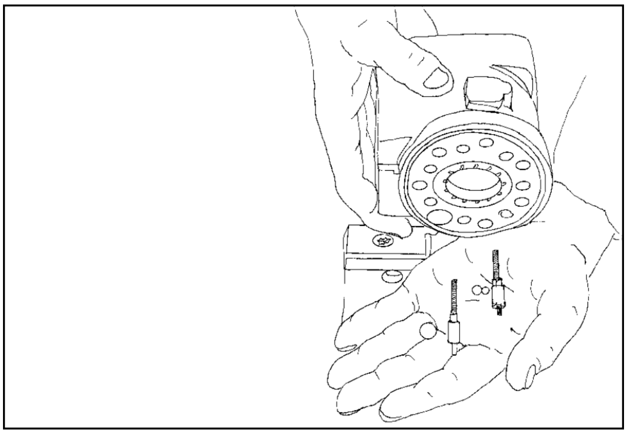
9. Shake out the check valve ball and suction valve pins and balls.

NOTE: *Replace pins prior to the reassembly.*



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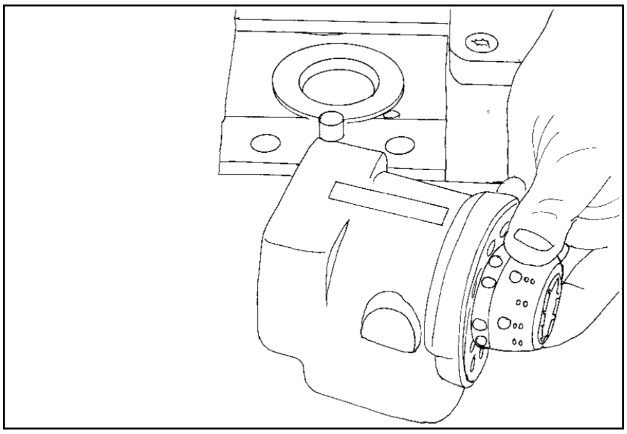
10. Take care to keep the cross pin in the sleeve and spool horizontal. The pin can be seen through the open end of the spool. Press the spool inwards and the sleeve, ring, bearing races and needle bearing will be pushed out of the housing together.



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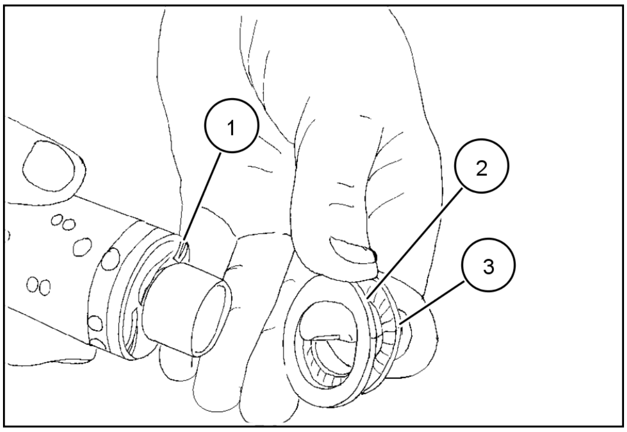
11. Take ring, **(1)**, bearing races, **(2)**, and needle bearing, **(3)**, from sleeve and spool. The outer (thin) bearing race can sometimes "stick" in the housing, therefore check that it has come out.



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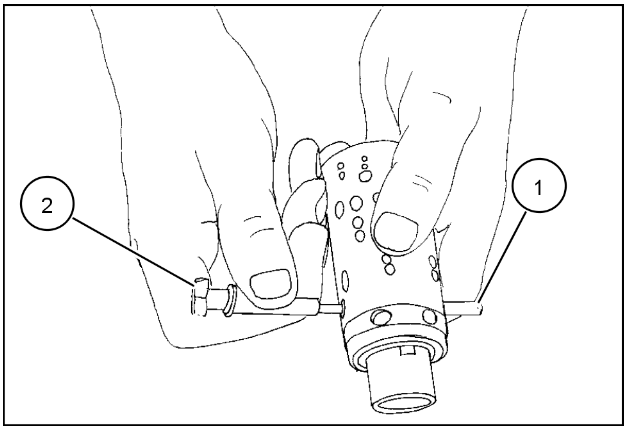
12. Press out the cross pin, **(1)**. Use the special screw, **(2)**, from the end cover.



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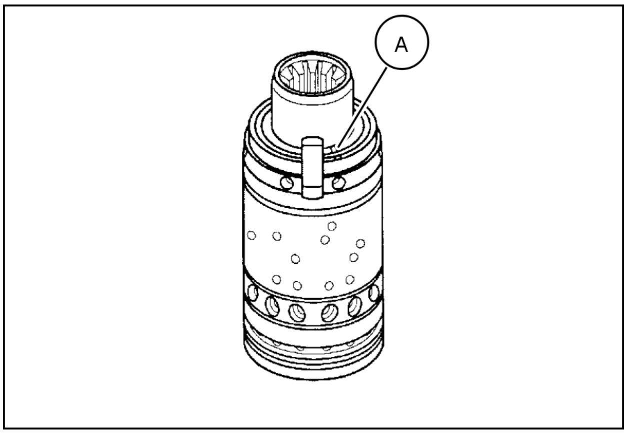
***NOTE:** A small mark, **(A)**, has been made with pumice stone on both spool and sleeve close to one of the slots for the neutral position springs, Figure **12**.*

If the mark is not visible, remember to leave a mark of your own on sleeve and spool before the neutral position springs are dismantled.



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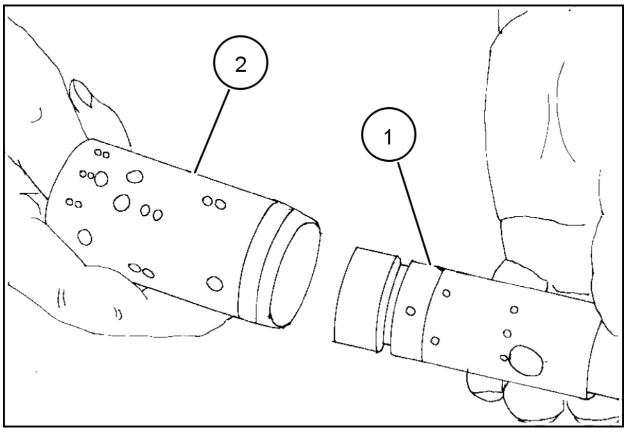
13. Carefully press the spool, **(1)**, out of the sleeve, **(2)**.



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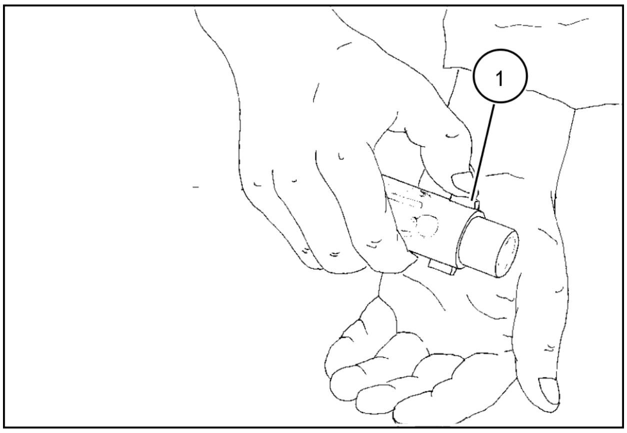
14. Press the neutral position springs, **(1)**, out of their slots in the spool.



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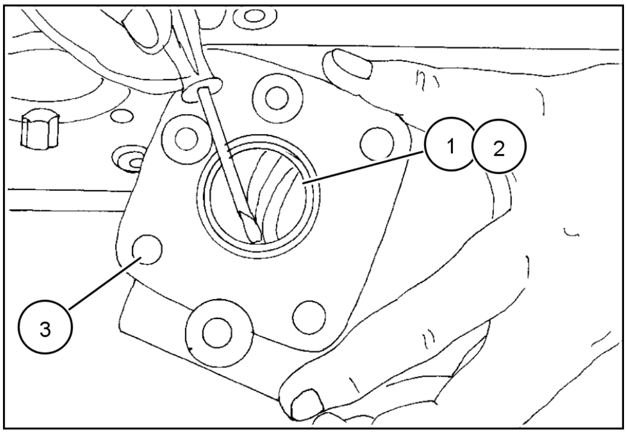
15. Remove dust seal **(1)** and Vari-Seal **(2)** from the control valve body **(3)**.



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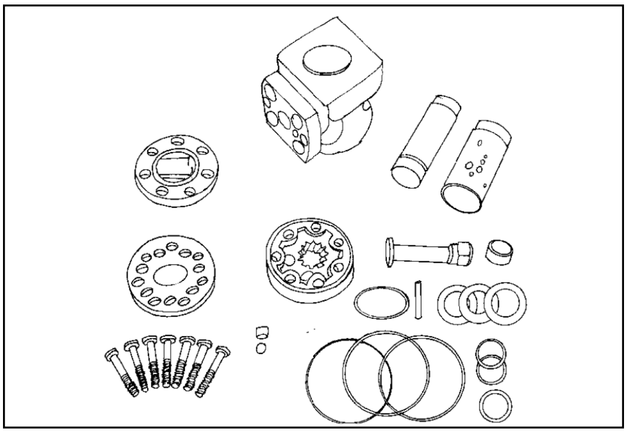
16. The steering unit OSPC is now completely dismantled.



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Next operation:
Control valve - Inspect Steering Motor (D.20.C)

Control valve - Inspect Steering Motor

Prior operation:
Control valve - Disassemble Steering Motor (D.20.C)

1. Clean all parts carefully.
2. Replace all seals and washers. Check all parts carefully and make any replacements necessary.
3. Before assembly, lubricate all parts with hydraulic oil.

Next operation:
Control valve - Assemble Steering Motor (D.20.C)

Control valve - Assemble Steering Motor

Prior operation:
Control valve - Inspect Steering Motor (D.20.C)

⚠ WARNING ⚠

Handle all parts carefully. Do not put your hands or fingers between parts. Always wear suitable safety items such as fitted clothing, safety goggles, gloves, shoes, etc. Failure to comply could result in death or serious injury.

M954A

⚠ WARNING ⚠

Always use suitable tools to align holes. DO NOT USE HAND OR FINGERS. Failure to comply could result in death or serious injury.

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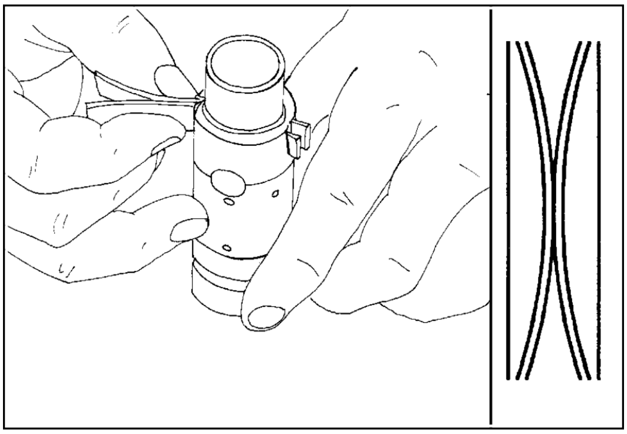
1. Place the flat neutral position springs in the slot. Place the curved springs between the flat ones and press them into the place.



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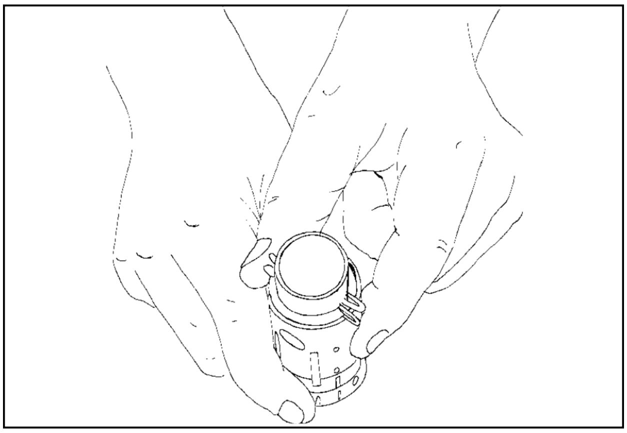
2. Line up the spring set.



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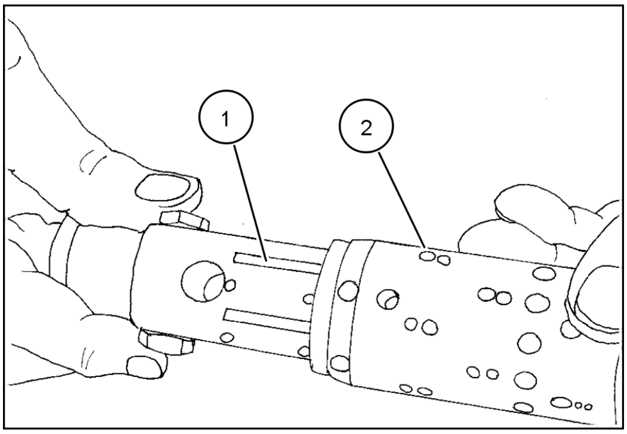
3. Guide the spool, **(1)**, into the sleeve, **(2)**. Make sure that spool and sleeve are placed correctly in relation to each other.



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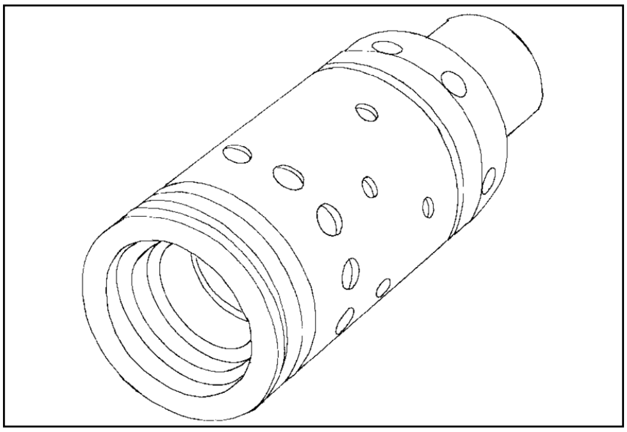
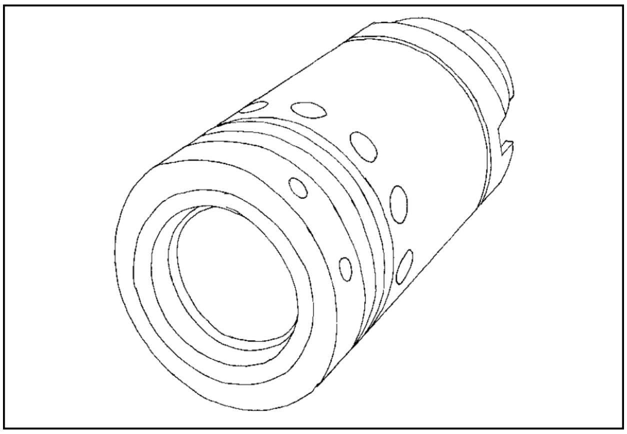
4. Assemble spool and sleeve.



20096293 4

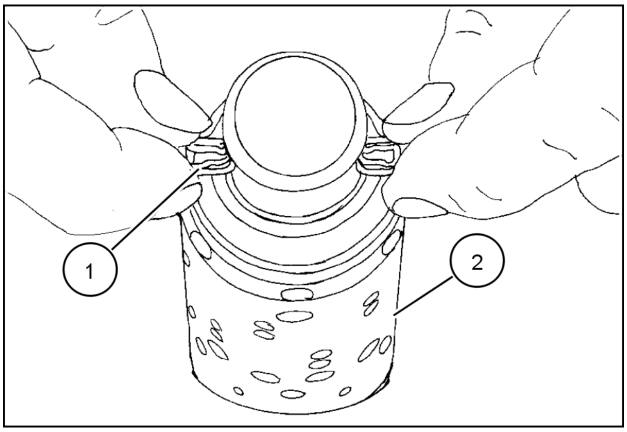
NOTE: *When assembling spool and sleeve, only two possible ways of positioning the spring slots are correct.*

There are three slots in the spool and three holes in the sleeve in the end of the spool/ sleeve, opposite to the end with spring slots. Place the slots and holes opposite each other so that parts of the holes in the sleeve are visible through the slots in the spool.



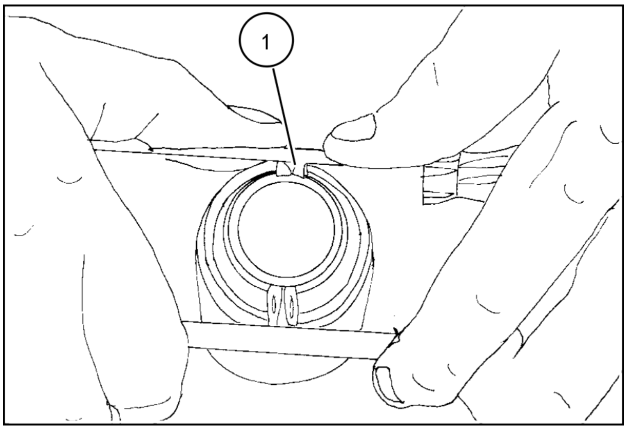
20096294 5

5. Press the springs, **(1)**, together and push the neutral position springs into place in the sleeve, **(2)**.



20096295 6

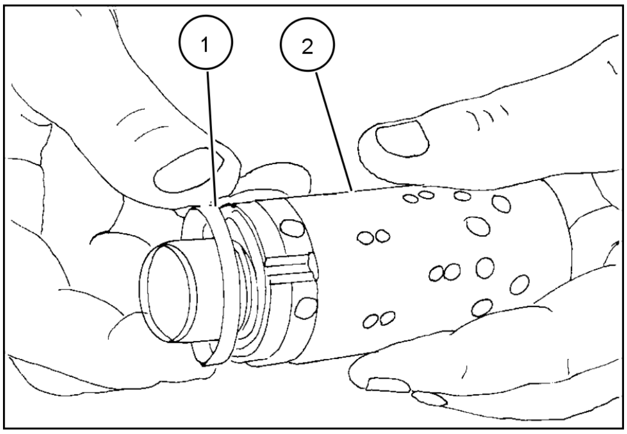
6. Line up the springs, **(1)**, and center them in the sleeve.



20096296 7

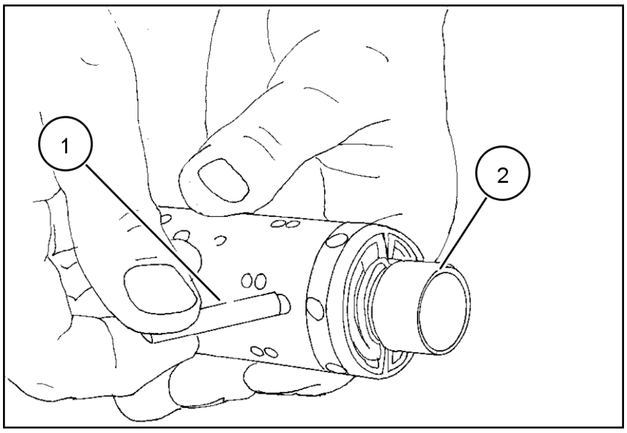
7. Guide the ring, **(1)**, down over the sleeve, **(2)**.

NOTE: *The ring should be able to move - free of the springs.*



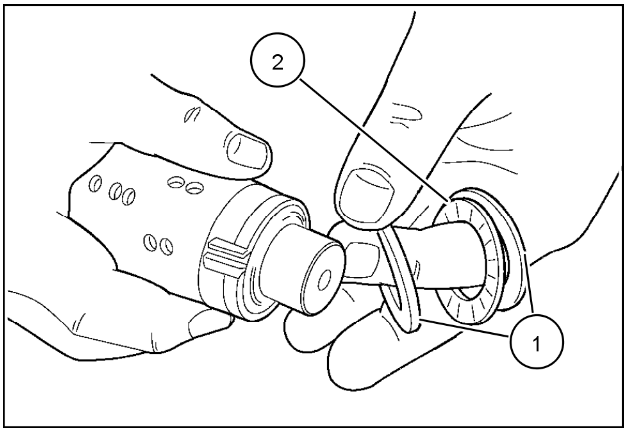
20096297 8

8. Install the cross pin, **(1)**, into the spool/sleeve, **(2)**.



20096298 9

9. Install bearing races, **(1)**, and needle bearing, **(2)**, onto the sleeve and spool assembly.



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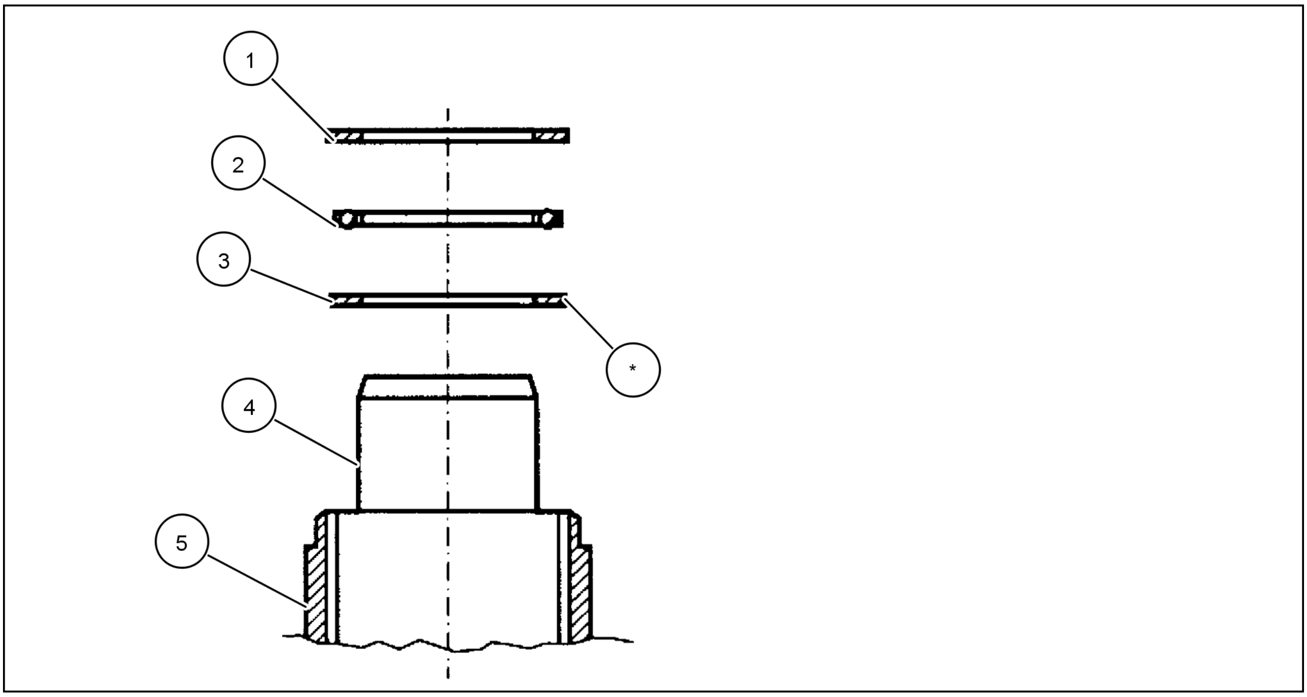
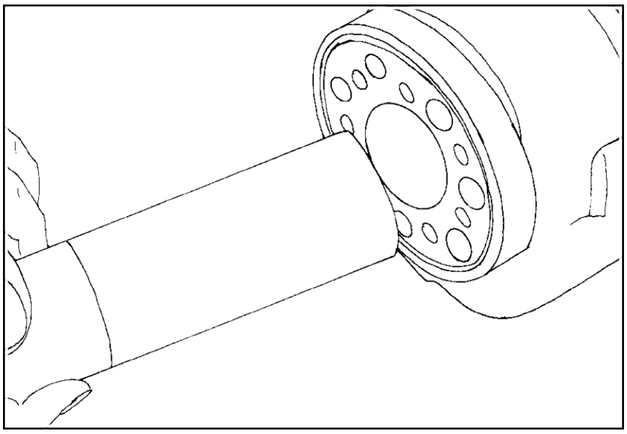


20096299 11

Assembly Pattern for Standard Bearing
*** The inside chamfer on the inner bearing race must face the inner spool**

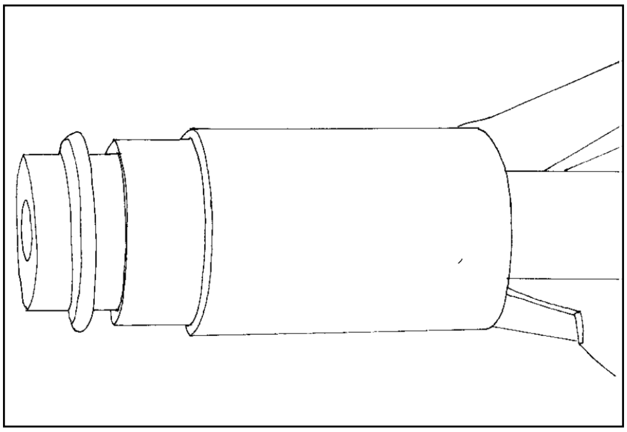
1. Outer bearing race	4. Spool
2. Needle bearing	5. Sleeve
3. Inner bearing race	

10. Turn the steering unit until the bore is horizontal in position. Guide the outer part of the assembly tool into the bore for the spool/sleeve.



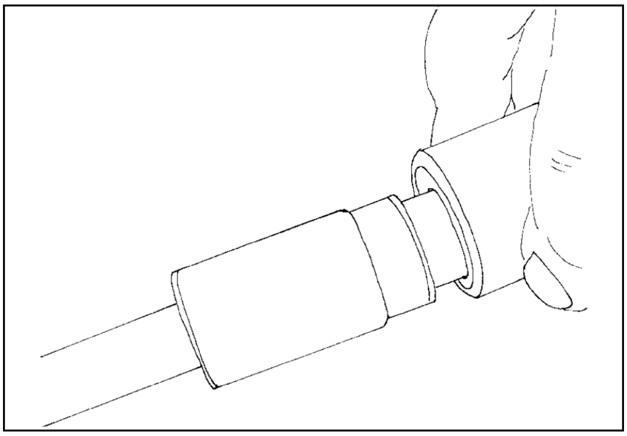
20096300 12

11. Lubricate the Vari-Seal with hydraulic oil and place them on the tool.



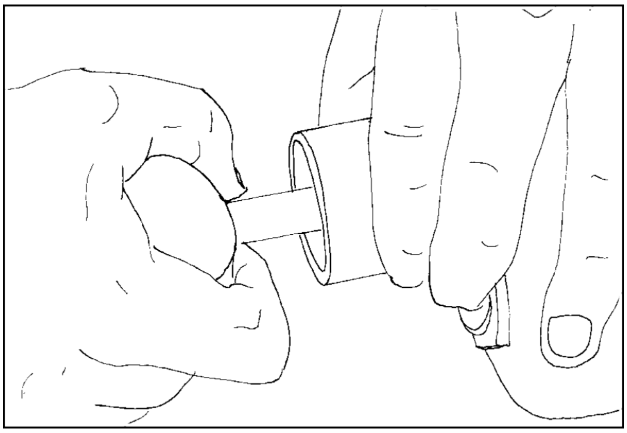
20096301 13

12. Hold the outer part of the assembly tool in the bottom of the steering unit housing and guide the inner part of the tool right to the bottom.



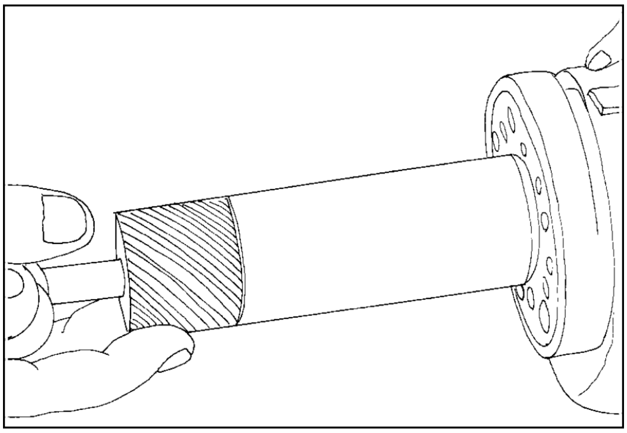
20096302 14

13. Press and turn the Vari-Seal into position in the housing.



20096303 15

14. Draw the inner and outer parts of the assembly tool out of the steering unit bore, leaving the guide from the inner part in the bore.



20096304 16

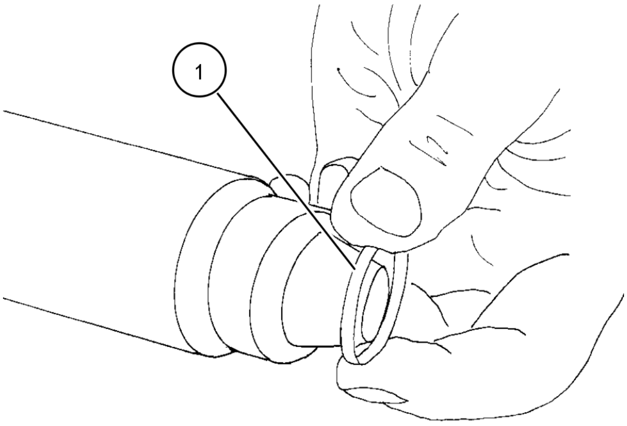
15.

⚠ WARNING ⚠

Always use suitable tools to align holes. DO NOT USE HAND OR FINGERS. Failure to comply could result in death or serious injury.

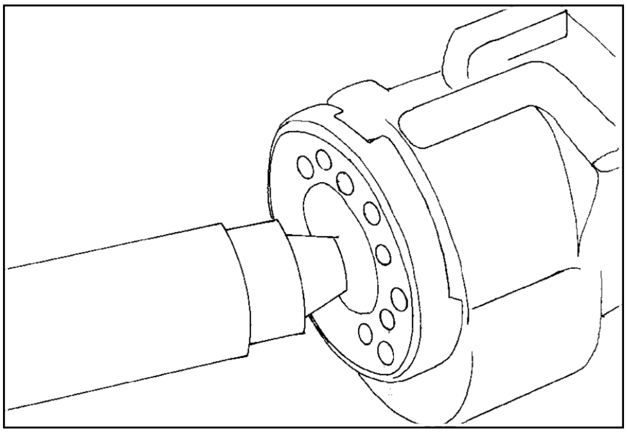
B020A

16. Lubricate the lip seal, **(1)**, with hydraulic oil and place it on the assembly tool.



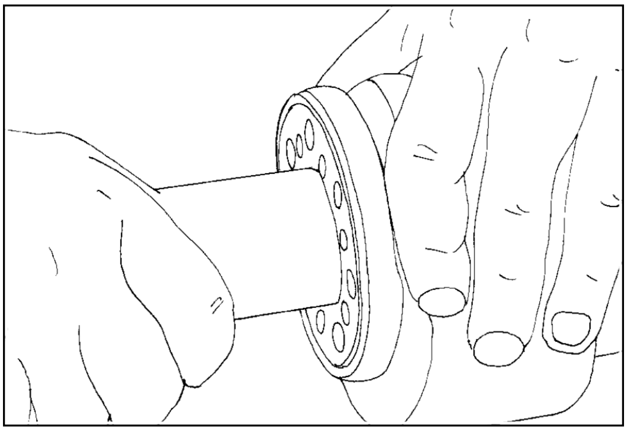
20096305 17

17. Guide the assembly tool right to the bottom.



20096306 18

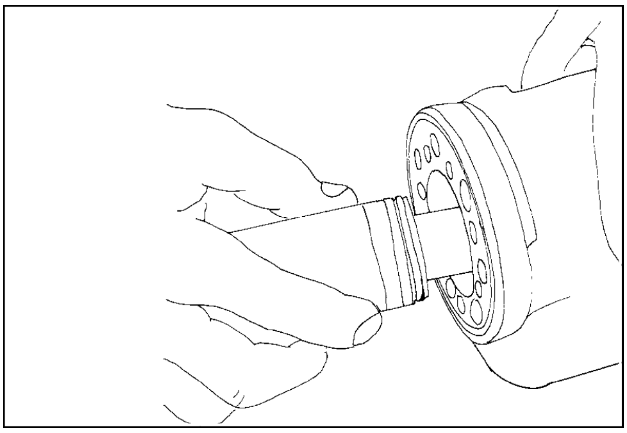
18. Press and turn the lip seal into place in the housing.



20096307 19

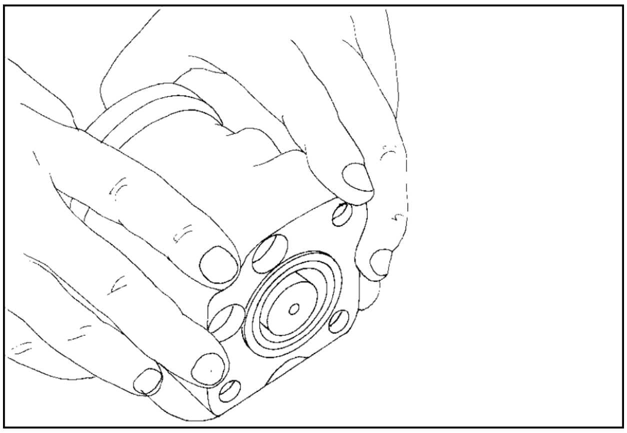
19. With a light turning movement, guide the spool and sleeve into the bore.

NOTE: *Fit the spool set holding the cross pin horizontal.*



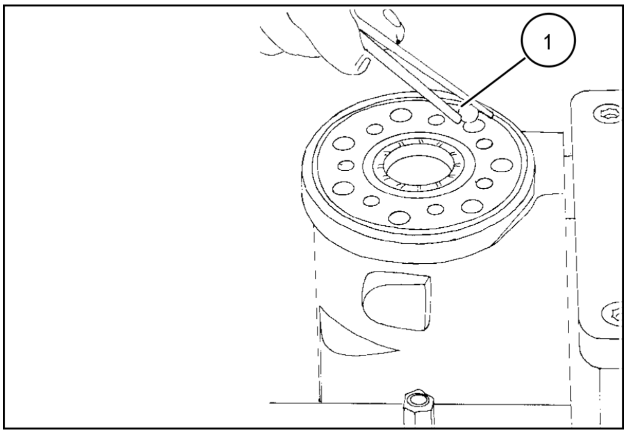
20096308 20

20. The spool set will push out the assembly tool guide. The Vari-Seal are now in position.



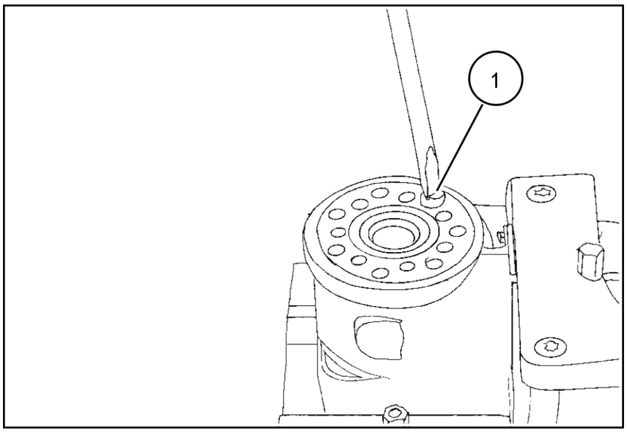
20096309 21

21. Turn the steering unit until the bore is vertical again. Put the check valve ball, **(1)**, into the hole indicated.



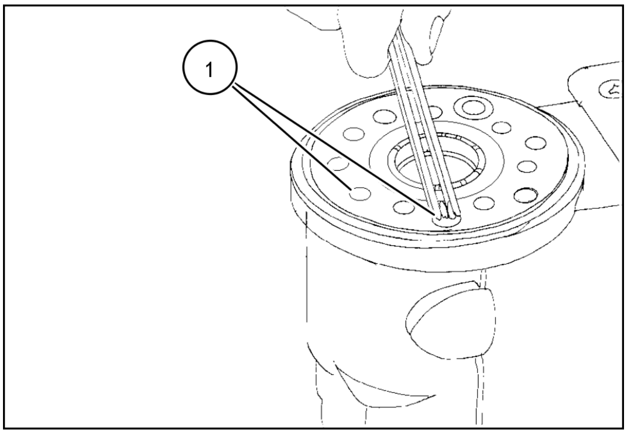
20096310 22

22. Screw the threaded bushing, **(1)**, lightly into the check valve bore. The top of the bushing must lie just below the surface of the housing.



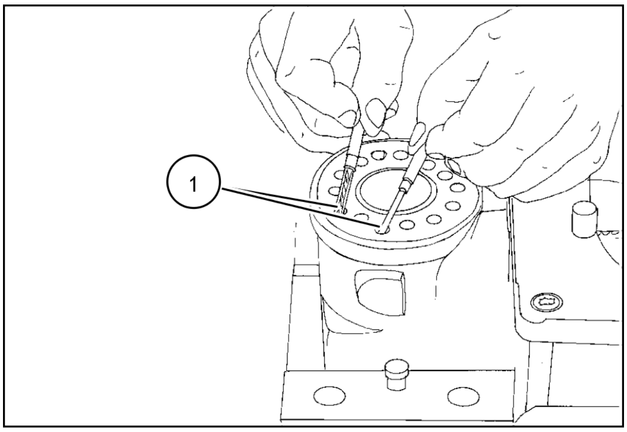
20096251 23

23. Place a ball in the holes, **(1)**.



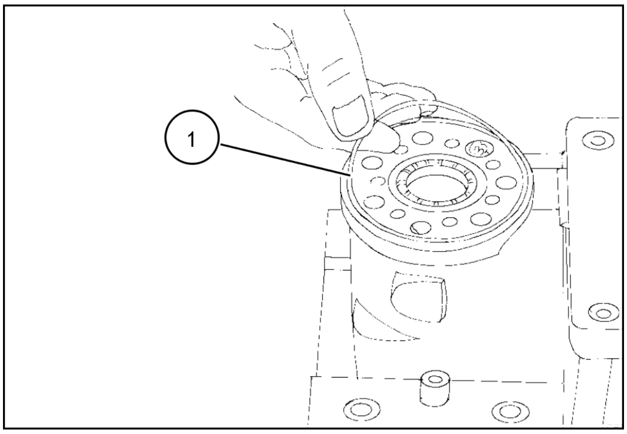
20096311 24

24. Place a new pins, **(1)**, in the same holes.



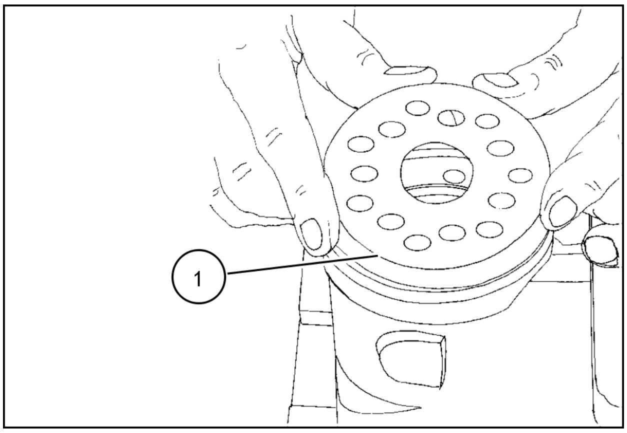
20096312 25

25. Lubricate the O-ring **(1)** with petroleum jelly.



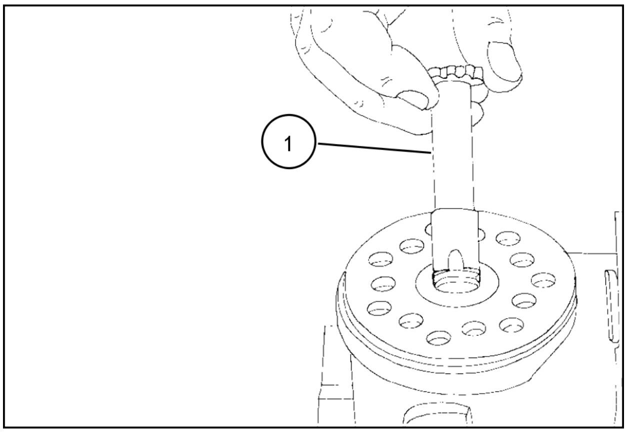
20096313 26

26. Place the distributor plate, **(1)**, so that the channel holes match the holes in the housing.



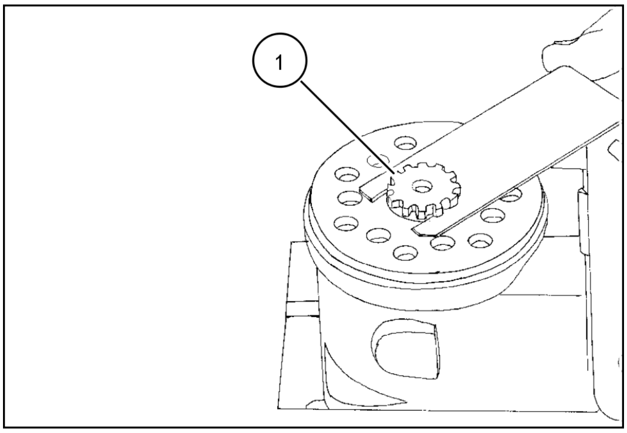
20096314 27

27. Guide the cardan shaft, **(1)**, down into the bore so that the slot is parallel with the connection flange.



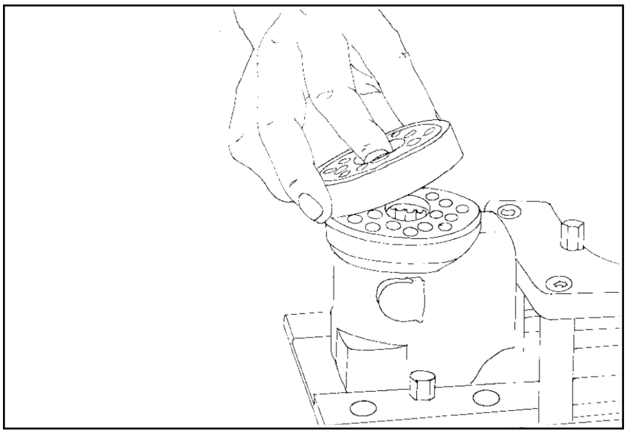
20096315 28

28. Place the cardan shaft, **(1)**, as shown, so that it is held in position by mounting fork.



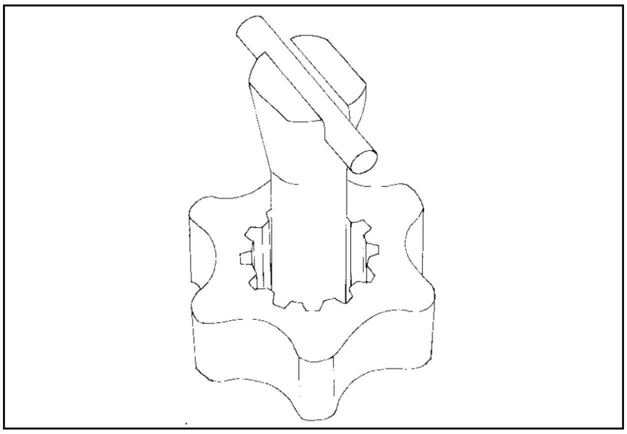
20096316 29

29. Lubricate O-rings with petroleum jelly and place them in the two grooves in the gear rim. Fit the rotor and rim on the cardan shaft.



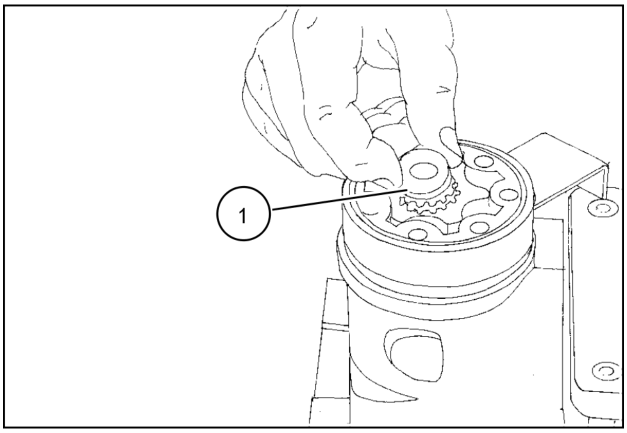
20096317 30

NOTE: *Fit the rotor and cardon shaft so that a tooth base in the rotor is positioned in relation to the shaft slot as shown. Turn the gear rim so that the seven through holes match the holes in the housing.*



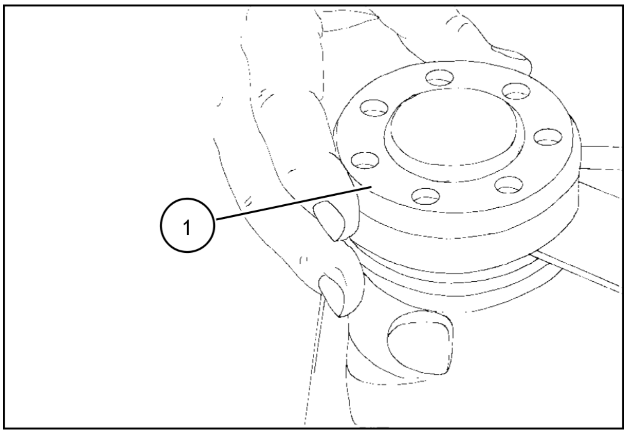
20096318 31

30. Install the spacer, **(1)**, if applicable.



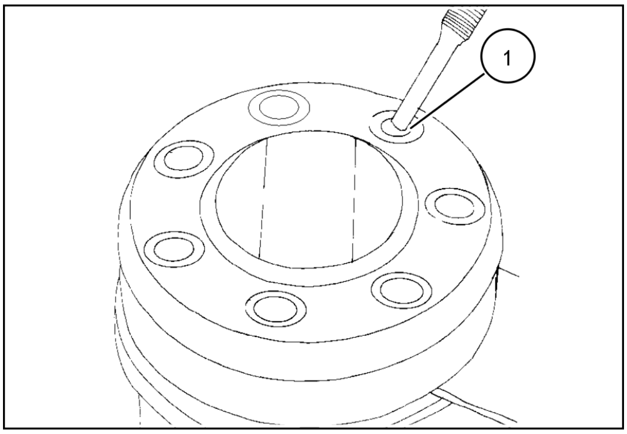
20096319 32

31. Place the end cover, **(1)**, in position.



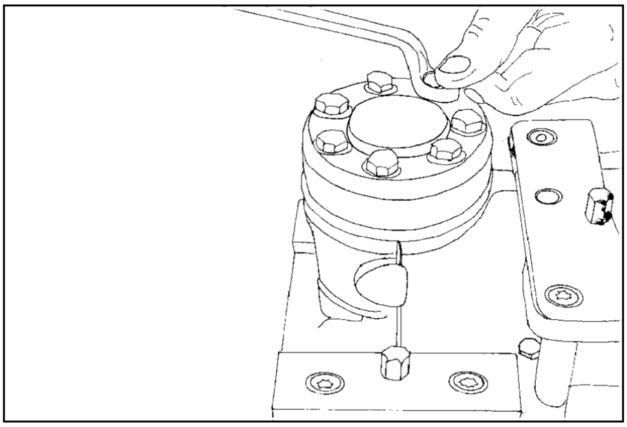
20096320 33

32. Install the special screw with washer in the cover, **(1)**.



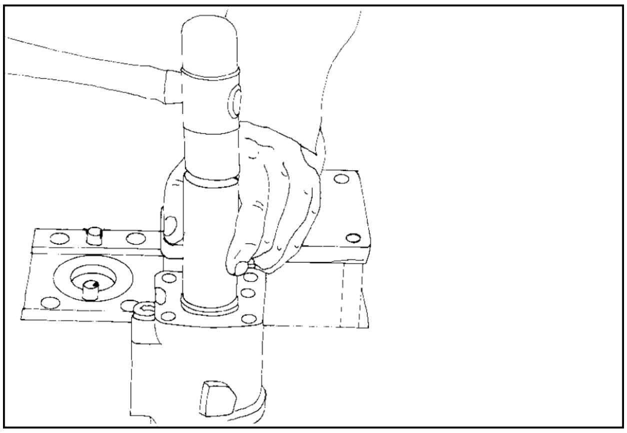
20096321 34

33. Install the screws with washers. Cross-tighten all the screws and the rolled pin with a torque of **3.0 - 3.6 N·m** (**27 - 32 lb in**). The steering motor can now be function tested.



20096246 35

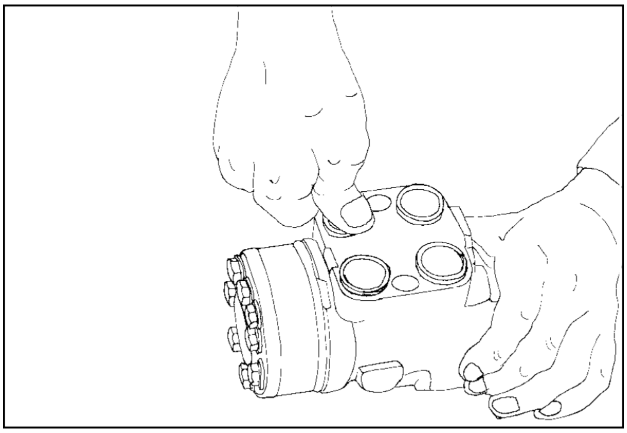
34. Install the dust seal in the housing using suitable tool and a plastic hammer.



20096322 36

35. Press the plastic plugs into the connection ports.

NOTE: *DO NOT USE A HAMMER!*



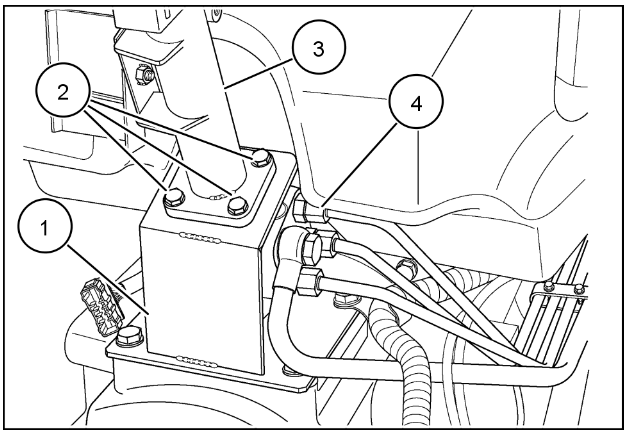
20096323 37

Next operation:
Control valve - Install Steering Motor (D.20.C)

Control valve - Install Steering Motor

Prior operation:
Control valve - Assemble Steering Motor (D.20.C)

1. Slide the steering motor back under the steering bracket, **(1)**, and reinstall the bolts, **(2)**, securing the steering column, **(3)**, and the motor together. Tighten the bolts.
2. Reconnect the four supply/return lines, **(4)**, with new O-rings and/or new Banjo Bolt sealing washers.
3. Install the rear hood panels, dash, instrument panel, and hood. See section Engine for procedures.

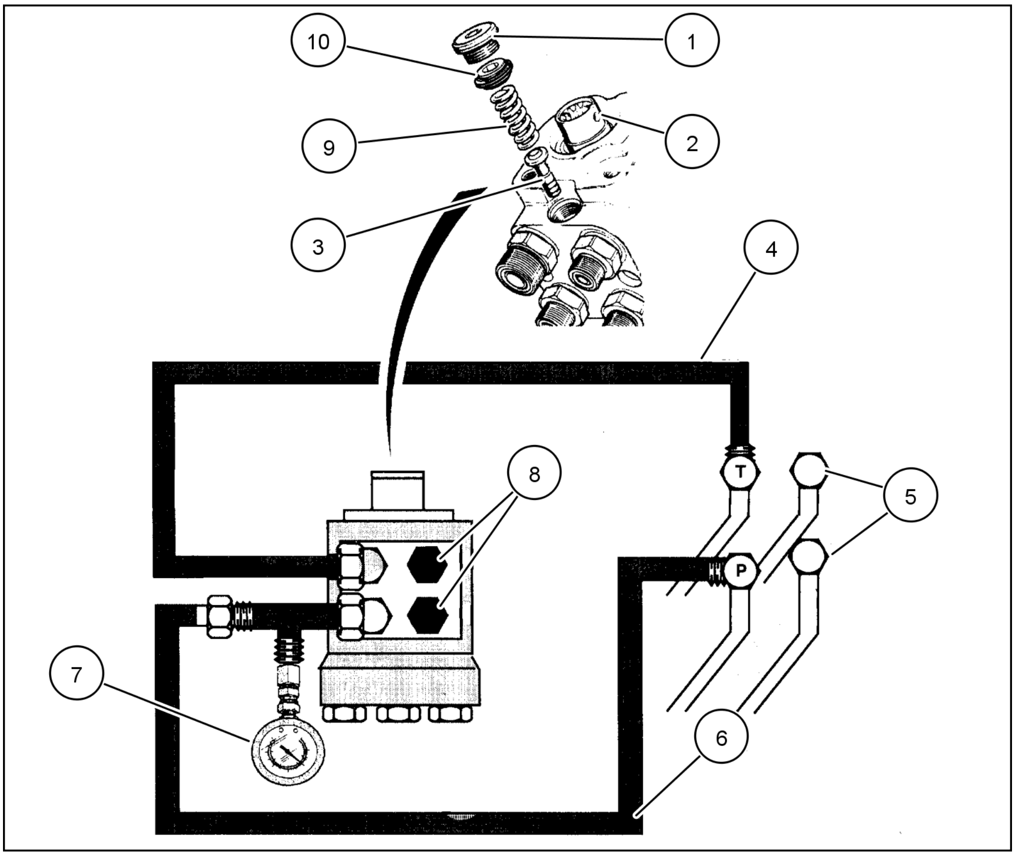


86071905 1

Relief valve - Adjust

NOTE: *To adjust the steering system relief valve it is necessary to remove the steering motor from the steering bracket, to gain access to the hexagon headed adjusting screw.*

1. Disconnect the steering motor from the steering bracket, and remove from the tractor refer to **Control valve - Remove Steering Motor (D.20.C)**
2. Fabricate suitable test hose to connect pump pipeline to steering motor. Connect locally procured ‘T’ joint between test hose and steering motor and Install pressure gauge as in Figure **1**.
3. Cap all connections to steering cylinder.
4. Connect the return hose normally. If required connect with extra hose and suitable adopter.
5. Start the engine and idle between **1450 - 1500 RPM**.Run the tractor until the transmission oil reaches normal working temperature.
6. With the engine running, turn the steering motor shaft to obtain full lock. The pressure gauge reading should read **10300 kPa** (**1494 psi**).
7. If the pressure readings are not correct, reset the adjuster, **(1)**, using an **6 mm** (**0.2 in**) hexagon key.



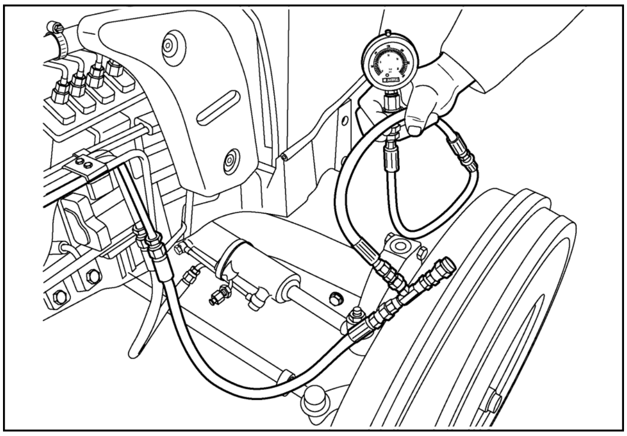
20096280 1

1.	Adjuster	6.	Hose for pump supply to steering motor
2.	Steering shaft	7.	Pressure gauge **20684 kPa** (**3000 psi**)
3.	Relief valve	8.	Cap
4.	Steering Motor Output Hose	9.	Spring
5.	Tractor tubes to steering cylinder	10.	Plug

Relief valve - Pressure test

NOTE: *There is no relief valve in steering pump and the following pressure test must only be performed as specified below. Failure to observe this precaution may result in severe damage to the hydraulic pump.*

1. Turn steering onto full left hand lock.
2. Disconnect left hand turn feed hose at steering cylinder.
3. Install Power steering pressure adapter fitting 380002744 with a **20684 kPa** (**3000 psi**) gauge. As shown in Figure **1**
4. Start tractor and set engine speed to **1450 RPM**.Turn steering wheel to the left with a pull of approximately **22 N** (**5 lb**) and observe the pressure reading.



86071904 1

NOTE: *The use of a force greater than **22 N** (**5 lb**) at the rim of the steering wheel may lead to slightly inaccurate readings due to the pumping action of the hydrostatic steering motor.*

If the steering test was satisfactory but pressure readings are away from specification the relief valve in the steering motor must be adjusted.

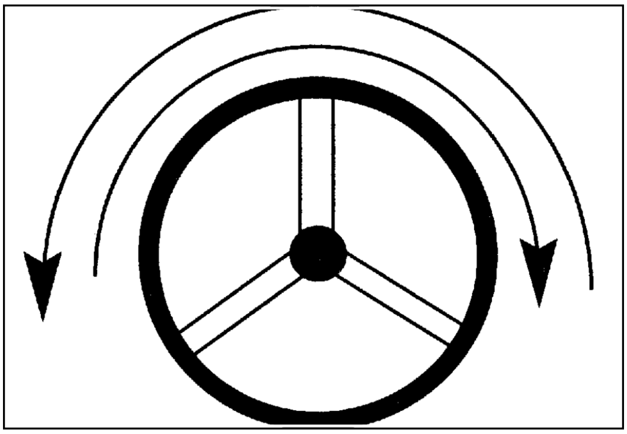
*The pressure reading should be **10300 kPa** (**1494 psi**)*

5. If the system pressure is not to specification proceed to Relief Valve Adjustment. **Relief valve - Adjust (D.20.C)**

Steering pump - Test

NOTE: *When the hydrostatic steering system is in operation, the pressure of oil supplied by the steering pump, to the steering motor, can rise towards the maximum setting of the steering motor relief valve, which is* ***10300 kPa*** *(**1494 psi**)*

There is no relief valve in the steering pump. The following practical test will determine if steering pump output is sufficient to allow satisfactory operation of the steering system.



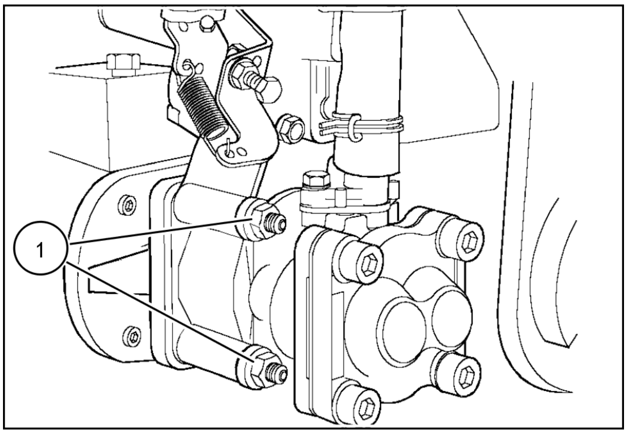
20096245 1

Steering Test

1. Set engine speed to **1000 RPM**.
2. Turn steering quickly from lock to lock. If steering is operating correctly the reaction of the steering should be immediate with no time delay between turning the steering wheel and movement of the wheels. At full lock the relief valve in the steering motor should be heard to blow and the engine speed should drop to approximately **970 RPM**.

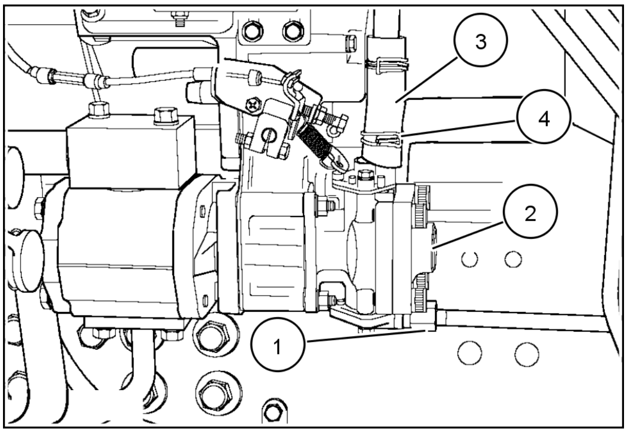
Steering pump - Install

1. Mount the power steering pump in position on the timing gear cover with two retaining bolts (not shown), and two retaining nuts, **(1)**.



20097788 1

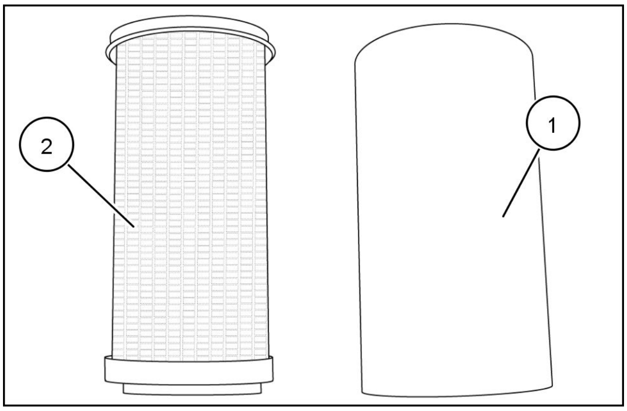
2. Attach the pressure tube, **(1)**, to the bottom of the steering pump, **(2)**.
3. Install the suction line, **(3)**, on the suction tube and install the hose clamp, **(4)**.



20097789 2

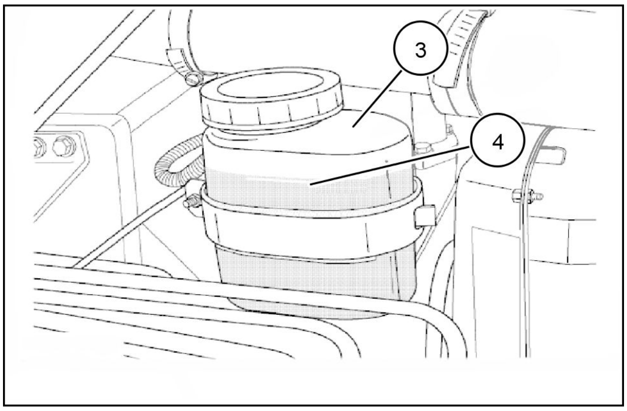
Reservoir - Inspect Hydrostatic steering reservoir

1. Remove the plastic filter container, **(1)**, and filter element, **(2)**, from the power steering reservoir, **(3)**, Figure **2**.
2. Clean hydrostatic steering filter element, **(2)**, with diesel fuel and dry before installing.



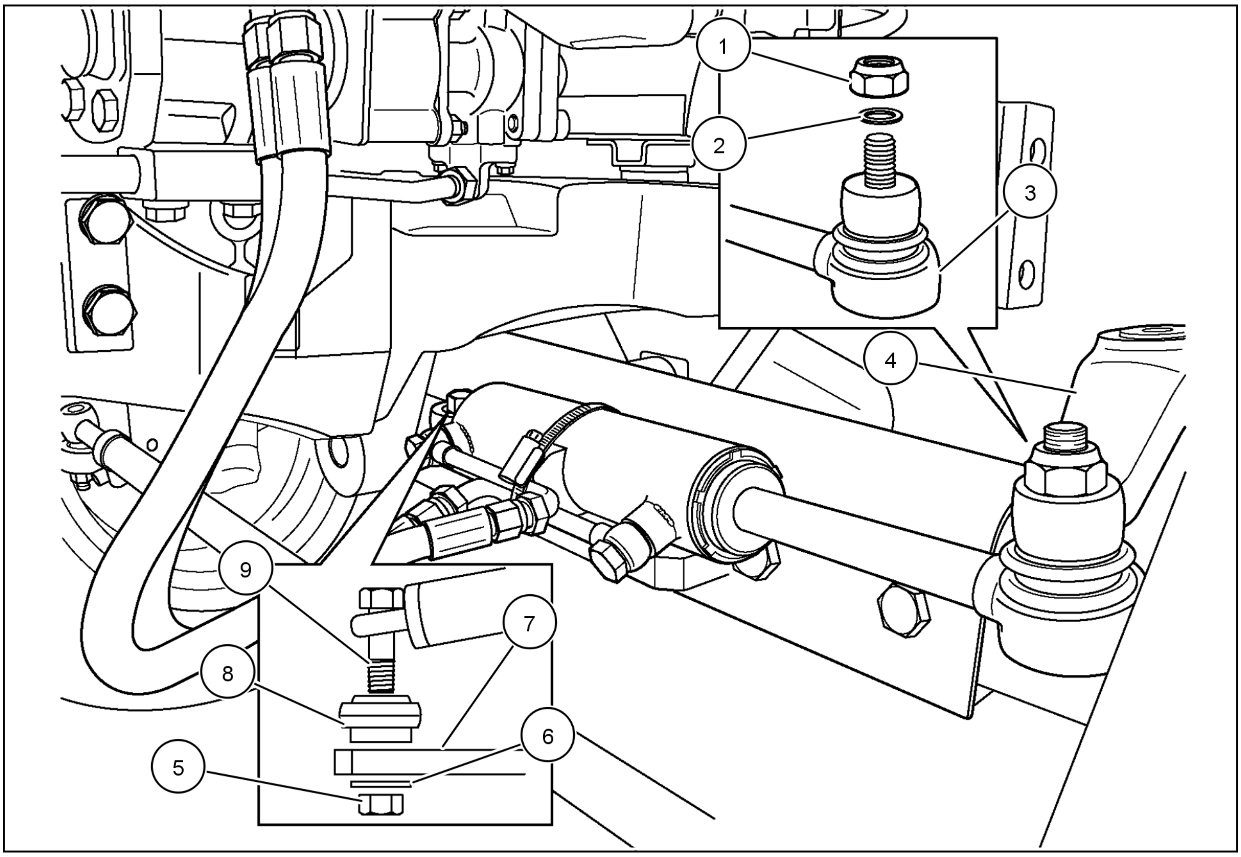
20099118 1

3. Install and fill the power steering reservoir, **(3)**, with fresh oil up to the line, **(4)**, on the reservoir. Replace the cap.
4. With the engine running, bleed the system by turning the steering wheel from lock to lock several times. Top up the reservoir, as required.
5. Use only Genuine **NEW HOLLAND AMBRA MULTI G 134** Transmission Oil
   Oil Capacity : **2.0 l** (**0.5 US gal**) (incl. pipes)



20099117 2

Cylinder - Remove Two wheel drive steering cylinder



86071906 1

1. Nut
2. Washer
3. Cylinder Rod Ball End
4. Steering Arm
5. Nut
6. Washer
7. Cylinder Mounting Bracket
8. Bushing
9. Bolt (Pivot Pin)

1. Stand the tractor on a hard level surface and position the front wheel in the straight ahead position.

2. Disconnect flexible hoses, cap the open hose ends and remove hose clamps.

NOTE: *Position of flexible hoses and orientation of connectors must be the same upon re-assembly.*

3. Remove the nut, **(1)**, and washer, **(2)**, securing the cylinder rod ball joint, **(3)**, to the steering arm, **(4)**, and separate the joint.

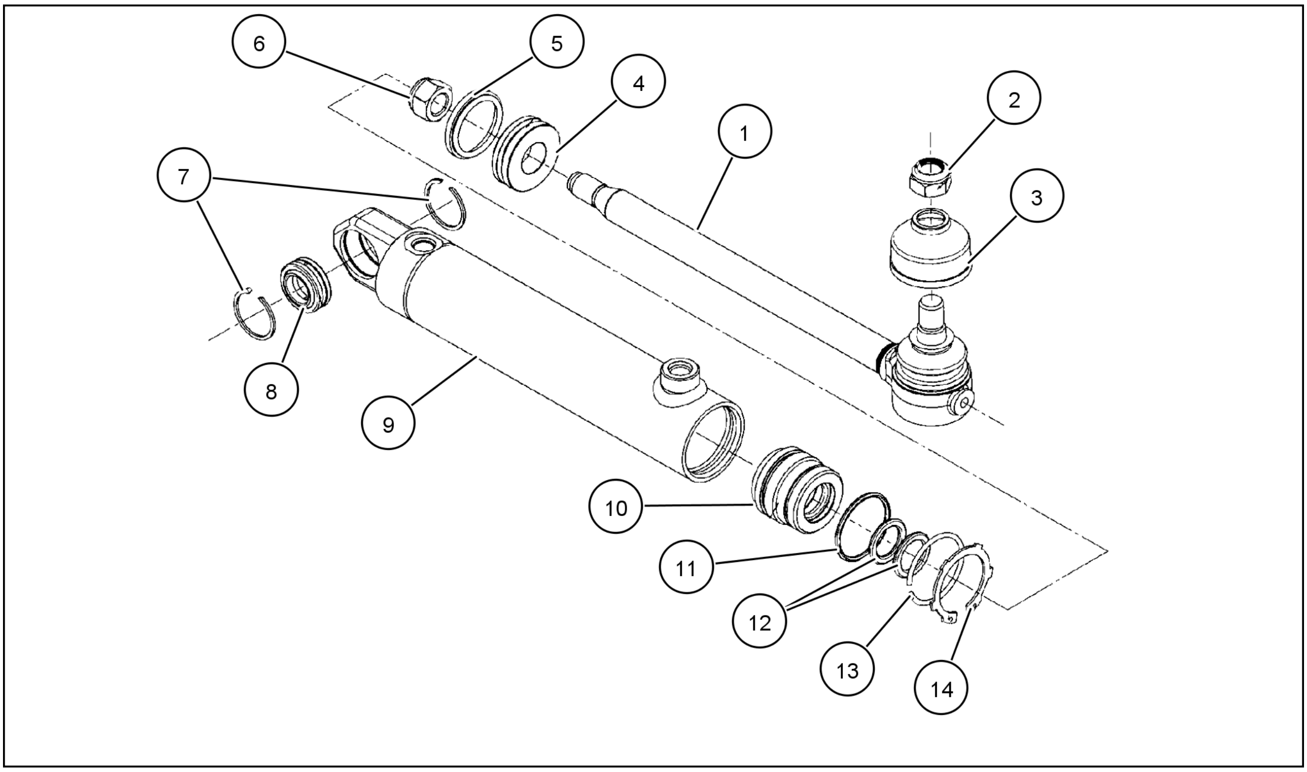
4. Remove the nut, **(5)**, securing the steering cylinder on front axle beam.

5. Remove the steering cylinder from the tractor and retrieve washer, **(6)**, bushing, **(8)**, and bolt (Pivot pin), **(9)**.

Next operation:
Cylinder - Disassemble Two wheel drive steering cylinder (D.20.C)

Cylinder - Disassemble Two wheel drive steering cylinder

Prior operation:
Cylinder - Remove Two wheel drive steering cylinder (D.20.C)



20096324 1

1.	Threaded Rod	8.	Bushing
2.	Nut	9.	Cylinder Barrel
3.	Rubber Boot	10.	Cylinder Rod Gland
4.	Piston with Seal	11.	O-ring
5.	Piston Seal	12.	Inner Head Seal
6.	Nut	13.	Locking Ring
7.	Locking Ring	14.	Circlip

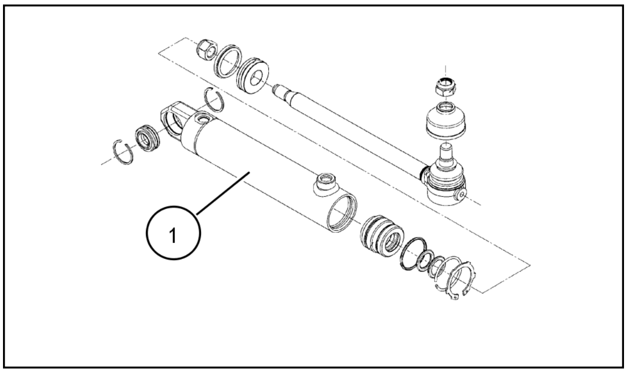
1. Secure the cylinder in a vise for disassembly.
2. Push the cylinder rod, **(1)**, into the cylinder barrel, **(9)**, so it is fully retracted.
3. Remove the circlip, **(14)**, from the cylinder rod, **(1)**.
4. Push the cylinder rod gland assembly, **(10)**, into the cylinder barrel and remove the locking ring, **(13)**.
5. Pull the rod and gland assembly from the cylinder barrel, **(9)**.
6. Remove the nut, **(6)**, from the cylinder rod, **(1)**, and disassemble to replace the seals.

Next operation:
Cylinder - Inspect (D.20.C)

Cylinder - Inspect

Prior operation:
Cylinder - Disassemble Two wheel drive steering cylinder (D.20.C)

1. Inspect the bore of the cylinder barrel, **(1)** and replace if necessary.
2. Lubricate all components during assembly.
3. Replace all seals supplied in the service seal kit.



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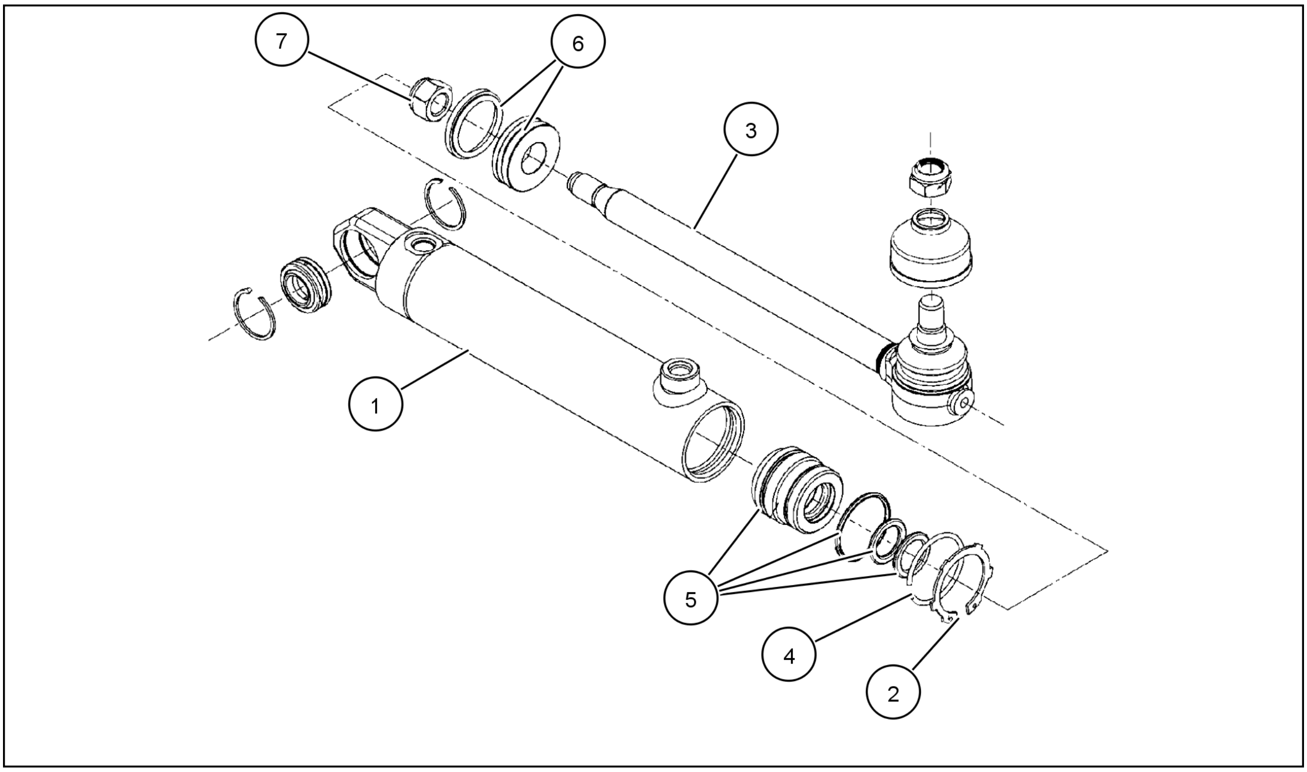
Next operation:
Cylinder - Assemble Two wheel drive steering cylinder (D.20.C)

Cylinder - Assemble Two wheel drive steering cylinder

Prior operation:
Cylinder - Inspect (D.20.C)



20096324 1

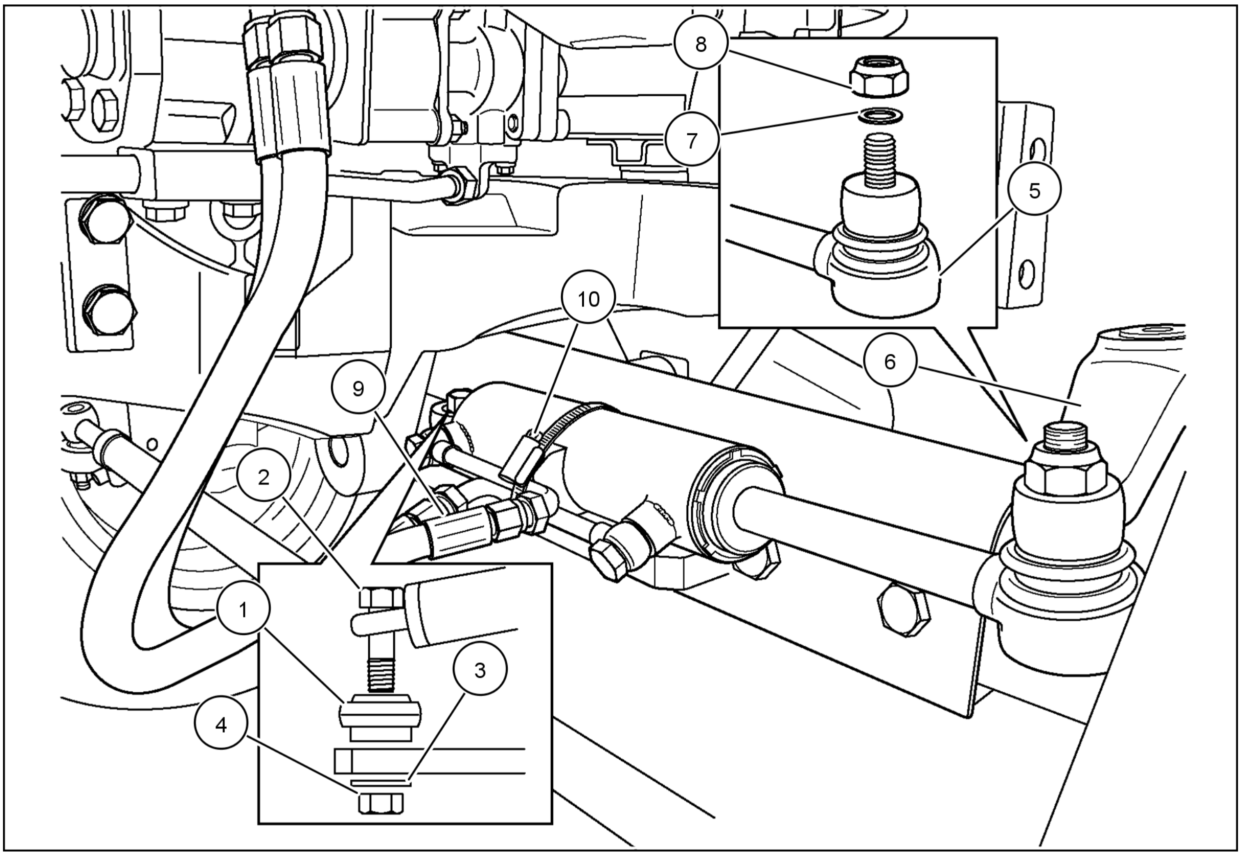
NOTE: *Lubricate all seals, O-rings and internal wall of cylinder barrel with hydraulic oil prior to assembly.*

1. Slide the circlip, **(2)**, onto the cylinder rod, **(3)**, followed by the locking ring, **(4)**, and the gland assembly, **(5)**.
2. Reattach the piston assembly, **(6)**. Secure the components on the shaft with nut, **(7)**. Torque the nut to **100 N·m** (**74 lb ft**).
3. Reinsert the rod and gland assembly into the cylinder barrel, **(1)**.
4. Push the gland assembly into the cylinder barrel and install the locking ring, **(4)**.
5. Reinstall the circlip, **(2)**.

Next operation:
Cylinder - Install Two wheel drive steering cylinder (D.20.C)

Cylinder - Install Two wheel drive steering cylinder

Prior operation:
Cylinder - Assemble Two wheel drive steering cylinder (D.20.C)



86071906 1

1. Place the steering cylinder onto the front axle beam.
2. Install the bushing, **(1)**, bolt, **(2)**, washer, **(3)**, and nut, **(4)**. Tighten hardware at this time.
3. Reinsert the cylinder rod ball joint, **(5)**, into the steering arm, **(6)**.
4. Secure the cylinder rod ball joint, with washer, **(7)**, and nut, **(8)**. Tighten hardware at this time.
5. Reconnect the flexible hoses, **(9)**, to the proper tubes on the steering cylinder. Secure the tubes with the hose clamp, **(10)**.

Steering cylinder - Remove - Four wheel drive steering cylinder

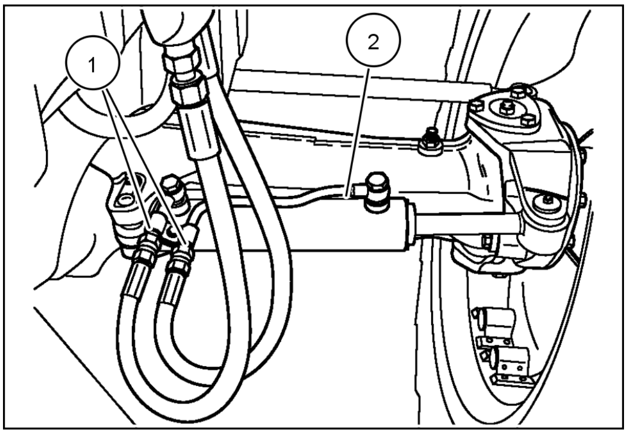
⚠ WARNING ⚠

Handle all parts carefully. Do not put your hands or fingers between parts. Always wear suitable safety items such as fitted clothing, safety goggles, gloves, shoes, etc. Failure to comply could result in death or serious injury.

M954A

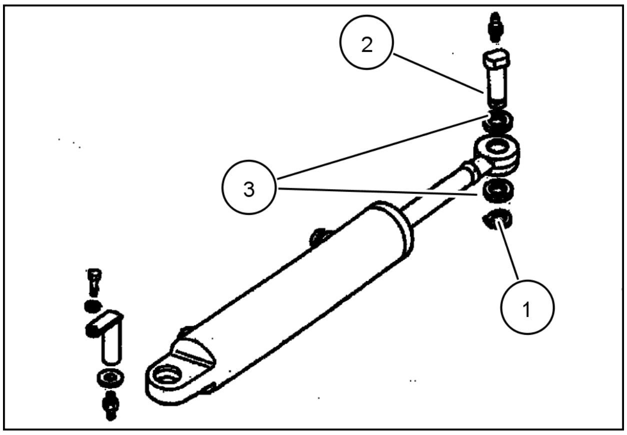
To remove the axle steering cylinder, proceed as follows

1. Disconnect the unions fixing the oil delivery and return hoses, **(1)**, to the cylinder, **(2)**.



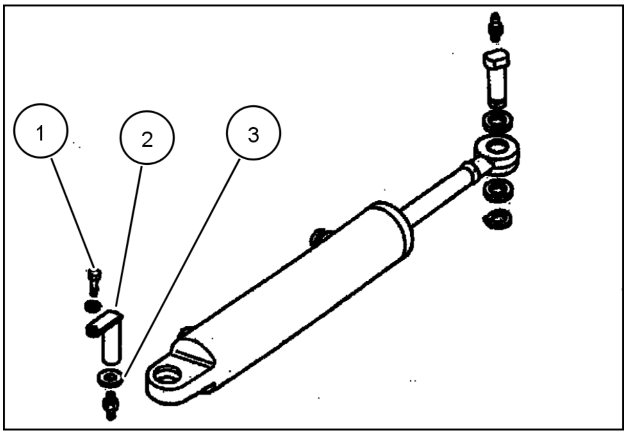
20097910 1

2. Remove the snap ring, **(1)**, pin, **(2)**, and spacers, **(3)**. that secure the cylinder to the axle steering arm.



20097911 2

3. Remove the bolt, **(1)**, pin, **(2)**, and spacer, **(3)**, that secure the cylinder to the axle body.



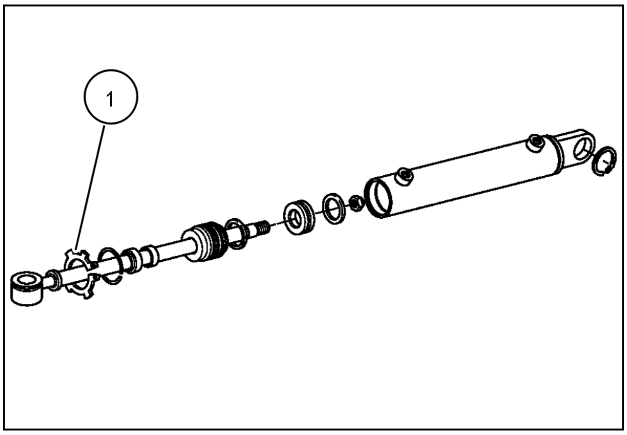
20097911 3

Next operation:
Steering cylinder - Disassemble - Four wheel drive steering cylinder (D.20.C)

Steering cylinder - Disassemble - Four wheel drive steering cylinder

Prior operation:
Steering cylinder - Remove - Four wheel drive steering cylinder (D.20.C)

1. Using a snap ring pliers, remove ring gland nut, **(1)**.



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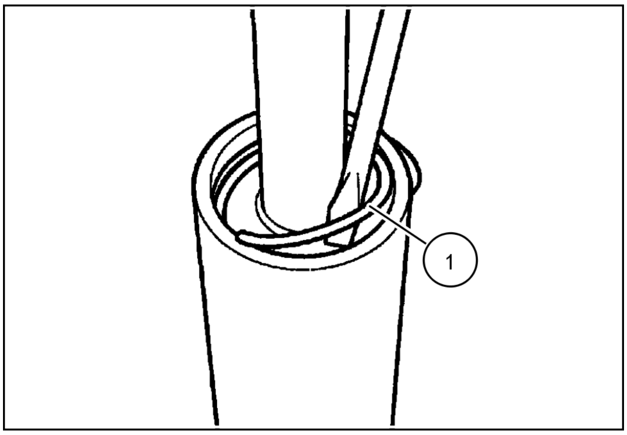
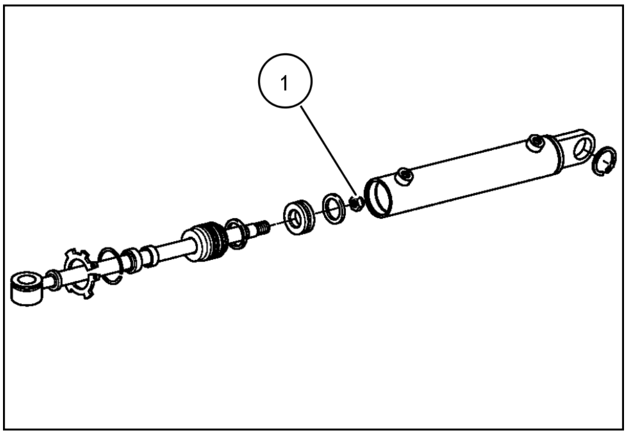
2. Push the steering cylinder gland into the cylinder and remove the wire locking ring, **(1)**.
3. Pull the rod and gland assembly from the cylinder.



20097913 2

4. Remove the piston rod nut, **(1)**, from the cylinder rod and disassemble to replace the seals.



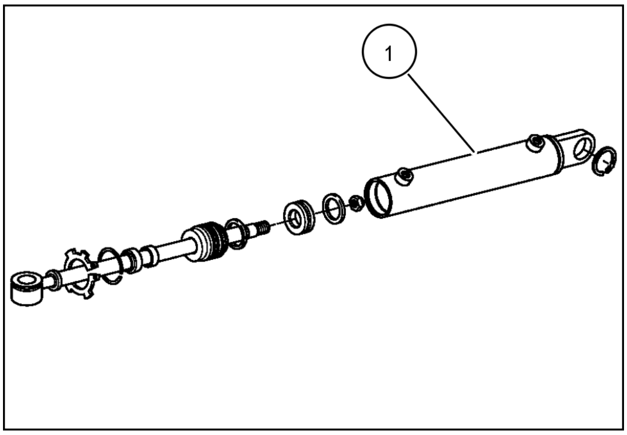
20097912 3

Next operation:
Steering cylinder - Inspect - Four wheel drive steering cylinder (D.20.C)

Steering cylinder - Inspect - Four wheel drive steering cylinder

Prior operation:
Steering cylinder - Disassemble - Four wheel drive steering cylinder (D.20.C)

1. Inspect the bore of the cylinder, **(1)** and replace if scored.
2. Lubricate all components while assembling.
3. Replace all seals supplied in the service seal kit.



20097912 1

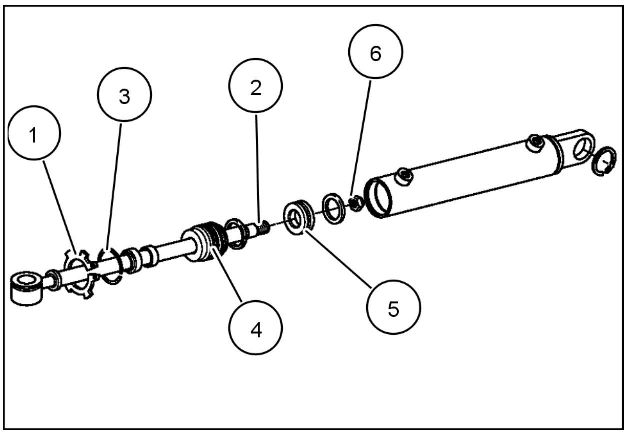
NOTE: *The seal located in the center of the gland is replaceable.*

Next operation:
Steering cylinder - Assemble - Four wheel drive steering cylinder (D.20.C)

Steering cylinder - Assemble - Four wheel drive steering cylinder

Prior operation:
Steering cylinder - Inspect - Four wheel drive steering cylinder (D.20.C)

1. Slide the gland nut, **(1)**, onto threaded rod, **(2)**. Install the locking ring, **(3)**, followed by slide guide assembly, **(4)**.
2. Next install the piston assembly, **(5)**. Secure the components on the shaft with nut, **(6)**.
3. Torque the M16 x 1.50 nut to **100 N·m** (**74 lb ft**).



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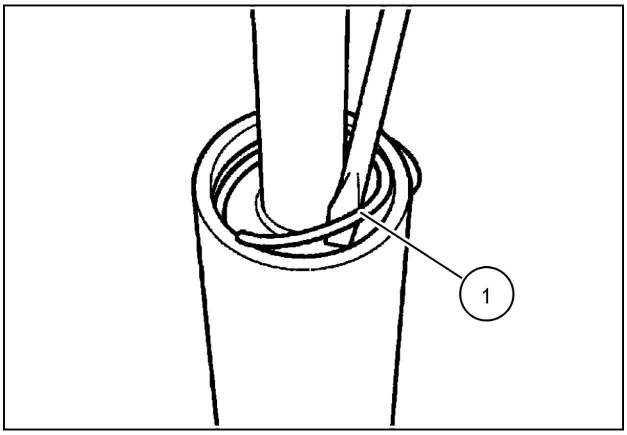
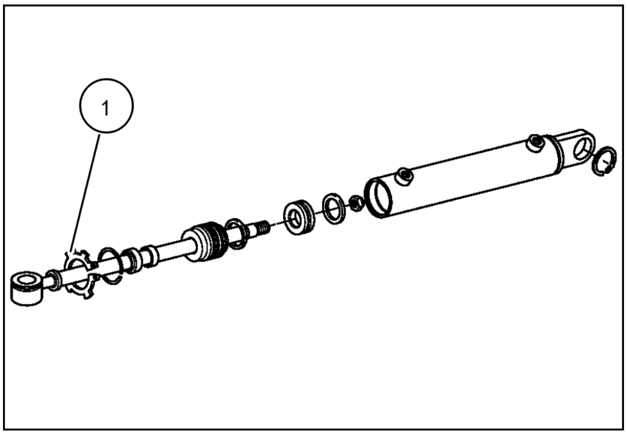
4. Install the rod and gland assembly into the cylinder.
5. Push the steering cylinder gland into the cylinder and install the wire locking ring, **(1)**.



20097913 2

6. Install and secure the ring gland nut, **(1)**.



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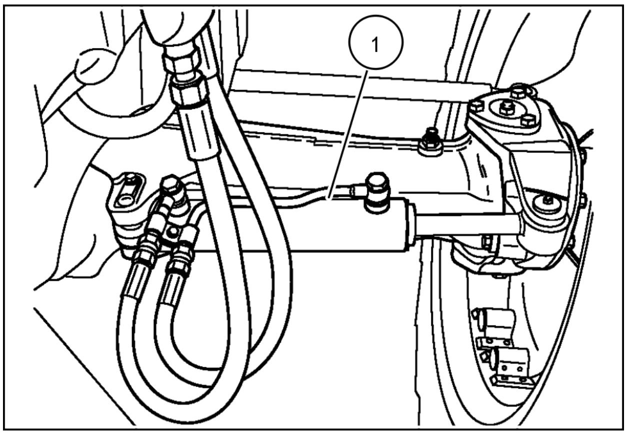
Next operation:
Steering cylinder - Install - Four wheel drive steering cylinder (D.20.C)

Steering cylinder - Install - Four wheel drive steering cylinder

Prior operation:
Steering cylinder - Assemble - Four wheel drive steering cylinder (D.20.C)

1. Place cylinder, **(1)**, into position.



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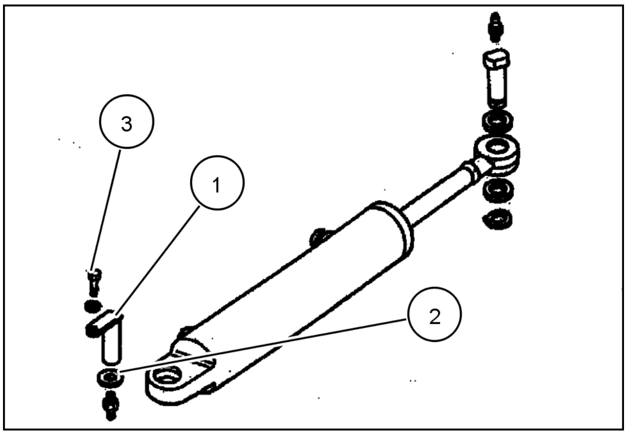
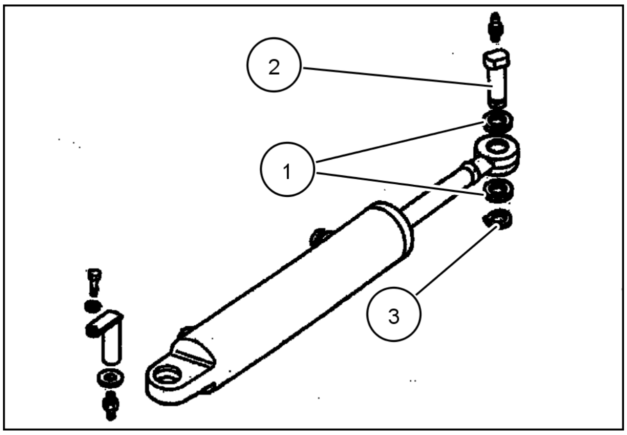
2. Install the pin, **(1)**, and spacer, **(2)**, that connect the cylinder to the axle body. Secure the pin in place with bolt, **(3)**.



20097911 2

3. Install top and bottom spacers, **(1)**, and pin, **(2)**, that connect the cylinder to the axle steering arm. Secure the pin with snap ring, **(3)**.



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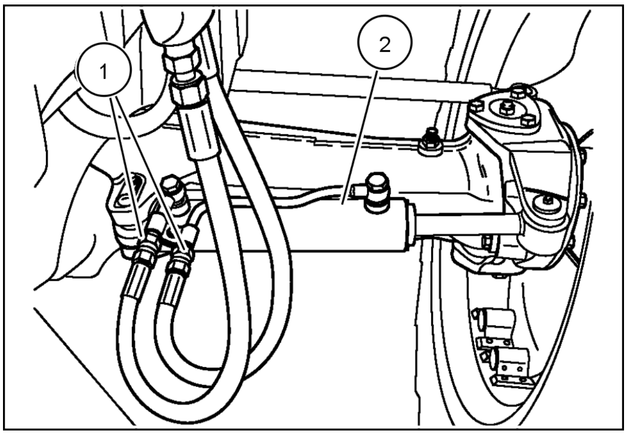
4. Connect the unions fixing the oil delivery and return hoses, **(1)**, to the cylinder, **(2)**.
5. Grease both pins with **NEW HOLLAND AMBRA GR-9 MULTI-PURPOSE GREASE**.
6. Fill system and check for leaks.



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STEERING Hydraulic - Troubleshooting

Problem	Possible Cause	Correction
Steering wheel is heavy to turn	No or insufficient oil pressure	
	a) Pump does not run	Start up pump (loose V-belt).
	b) Pump defective	Repair or replace pump.
	d) Pump is worn out	Correct direction of rotation of pump or replace pump.
	e) Pump is under dimensioned	Install a larger pump (examine pressure need and flow).
	Pressure relief valve is stuck in open position or setting pressure is too low.	Repair or clean pressure relief valve.Adjust the valve to the correct pressure.
	Too much friction in the mechanical parts of the vehicle.	Lubricate bearings and joints of steering gear or repair if necessary. Check steering column installation.
	Emergency steering balls missing.	Install new balls.
	Combination: Downstream system + steering unit with suction valve and differential cylinder are inexpedient.	Change cylinder type (through going piston rod).
Regular adjustments of the steering wheel are necessary - Snake-like driving	Leaf spring without spring force or broken.	Replace leaf springs.
	Gear wheel set worn.	Replace gear wheel set.
	Cylinder seized or piston seals worn.	Replace defective parts.
Neutral position of steering wheel cannot be obtained, i.e. there is a tendency towards "Motoring"	Steering Column and steering unit out of line.	Align the steering column with steering unit.
	Too little or no play between steering column and steering unit input shaft.	Adjust the play and, if necessary, shorten the splines journal.
	Pinching between inner and outer spools.	Contact your Authorized New Holland Dealer.
"Motoring" effect. The steering wheel can turn on its own	Leaf springs are stuck or broken and have therefore reduced spring force.	Replace leaf springs.
	Inner and outer spools pinch, possible due to dirt.	Clean steering unit or Contact your Authorized New Holland Dealer.
	Return pressure in connection with the reaction between differential cylinder and steering unit too high.	Reduce return pressure, change cylinder type or use a non-reaction control unit.
Backlash	Cardan shaft fork worn or broken.	Replace cardan shaft
	Leaf springs without spring force or broken.	Replace leaf springs.
	Worn splines on the steering column.	Replace steering column.
"Shiny"-effect. The steered Wheels vibrate. (Rough tread on tyres gives vibrations)	Air in the steering cylinder.	Bleed cylinder. Find and remove the reason for air collection.
	Mechanical connections or wheel bearings worn.	Replace worn parts.
Steering wheel can be turned the whole time without the steered wheels moving	Oil is needed in the tank.	Fill with clean oil and bleed the system.
	Steering cylinder worn.	Replace or repair cylinder.
	Gear wheel set worn.	Replace gear wheel set.
	Spacer across cardan shaft forgotten.	Install spacer.
Steering wheel can be turned slowly in one or both directions without the steered wheels turning	One or both anti-cavitation valves are leaky or are missing in OSPC .	Clean or replace defect or missing valves.

Problem	Possible Cause	Correction
Steering is too slow and heavy when trying to turn quickly	Insufficient oil supply to steering unit, pump defective or number of revolutions too low.	Replace pump or increase number of revolutions.
	Relief valve setting too low.	Adjust valve to correct setting.
	Relief valve sticking owing to dirt.	Clean the valve.
"Kick - back" in steering wheel from system. Kicks from wheels	Fault in the system.	Contact your Authorized New Holland Dealer or Danfoss.
Heavy kick - back in steering wheel in both directions.	Wrong setting of cardan shaft and gear wheel set.	Correct setting as shown in Service Manual.
Turning the steering wheel activates the steered wheels opposite	Hydraulic hoses for the steering cylinders have been switched around.	Reverse the hoses.
Hard point when starting to turn the steering wheel	Oil is too thick cold.	Let motor run until oil is warm.
Too little steering force (possibly to one side only)	Pump pressure too low.	Correct pump pressure.
Leakage at either input shaft, end cover, gear-wheel set, housing or top part.	Shaft defective.	Replace shaft seal.
	Screws loose.	Tighten screws.
	Washers or O-rings defective.	Replace washers and O-rings.

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AXLES, BRAKES AND STEERING - D

SERVICE BRAKE Mechanical - 30.B

Workmaster 45
Workmaster 55

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Brake - General specification

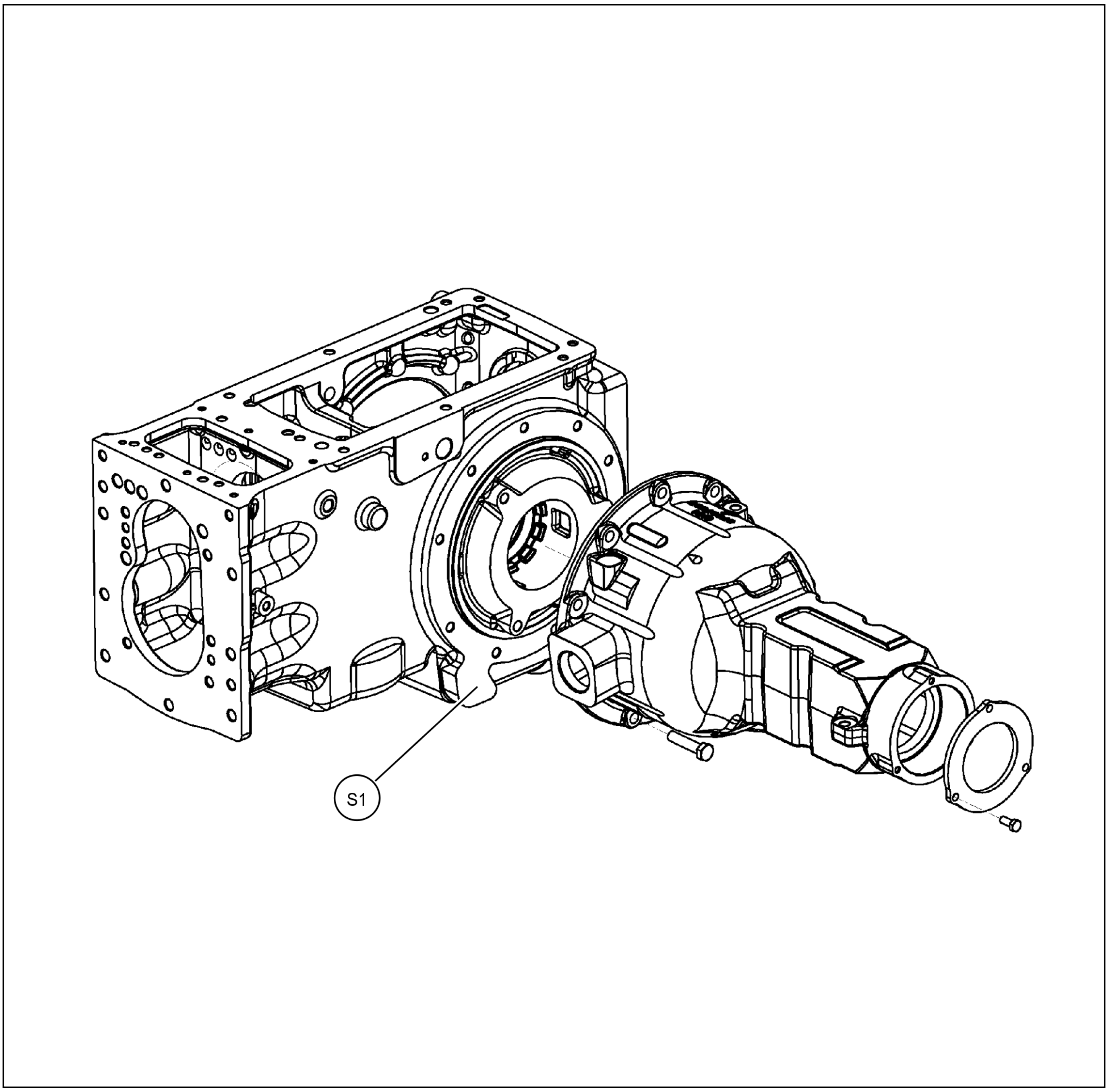
Type	Oil immersed disc brakes acting on differential axle shaft
Control	
Service Brake	Mechanical , independent Pedal control
Parking Brake	Mechanical, Hand lever Pull type
No. of Discs per side	3
Brake Oil Specification	APGSAE 20W30
Nominal Brake Disc Thickness	**4.65 mm** (**0.183 in**)
Service/Parking Brakes Disc discard Thickness	**4.30 mm** (**0.169 in**)
Brake Pedal Free Play	**50 - 55 mm** (**1.97 - 2.17 in**)

Brake - Special tools

Description	Tool No.
Insaller brake boot in trumpet housing	80411000
Insaller rubber boot outer in brake linkage groove	80412000

Brake - Sealing

Operation Description	Sealant Specification
Buckle up of Rear Axle Housing to Differential Housing **(S1)**	**LOCTITE 518**



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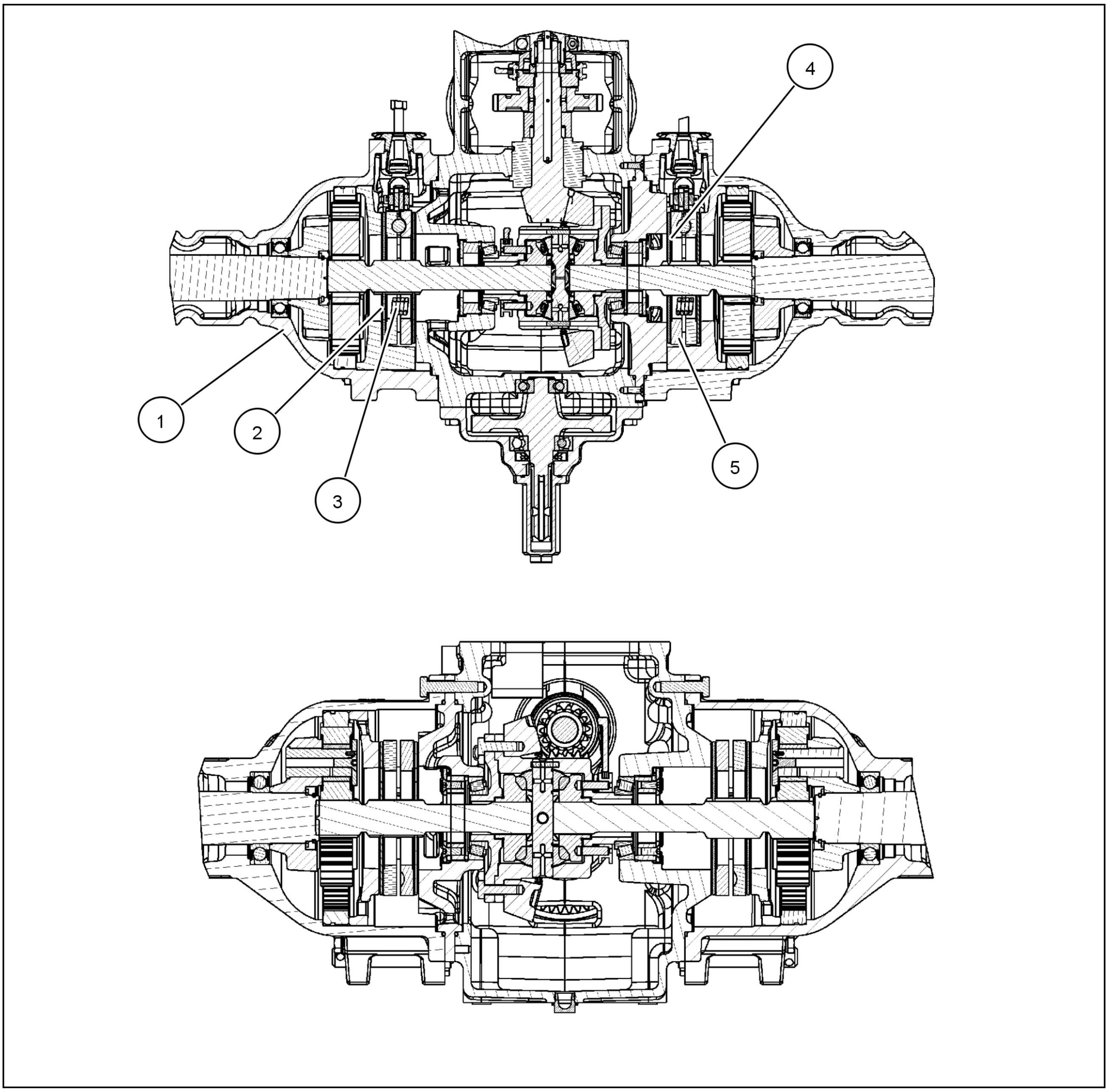
Brake - Sectional view



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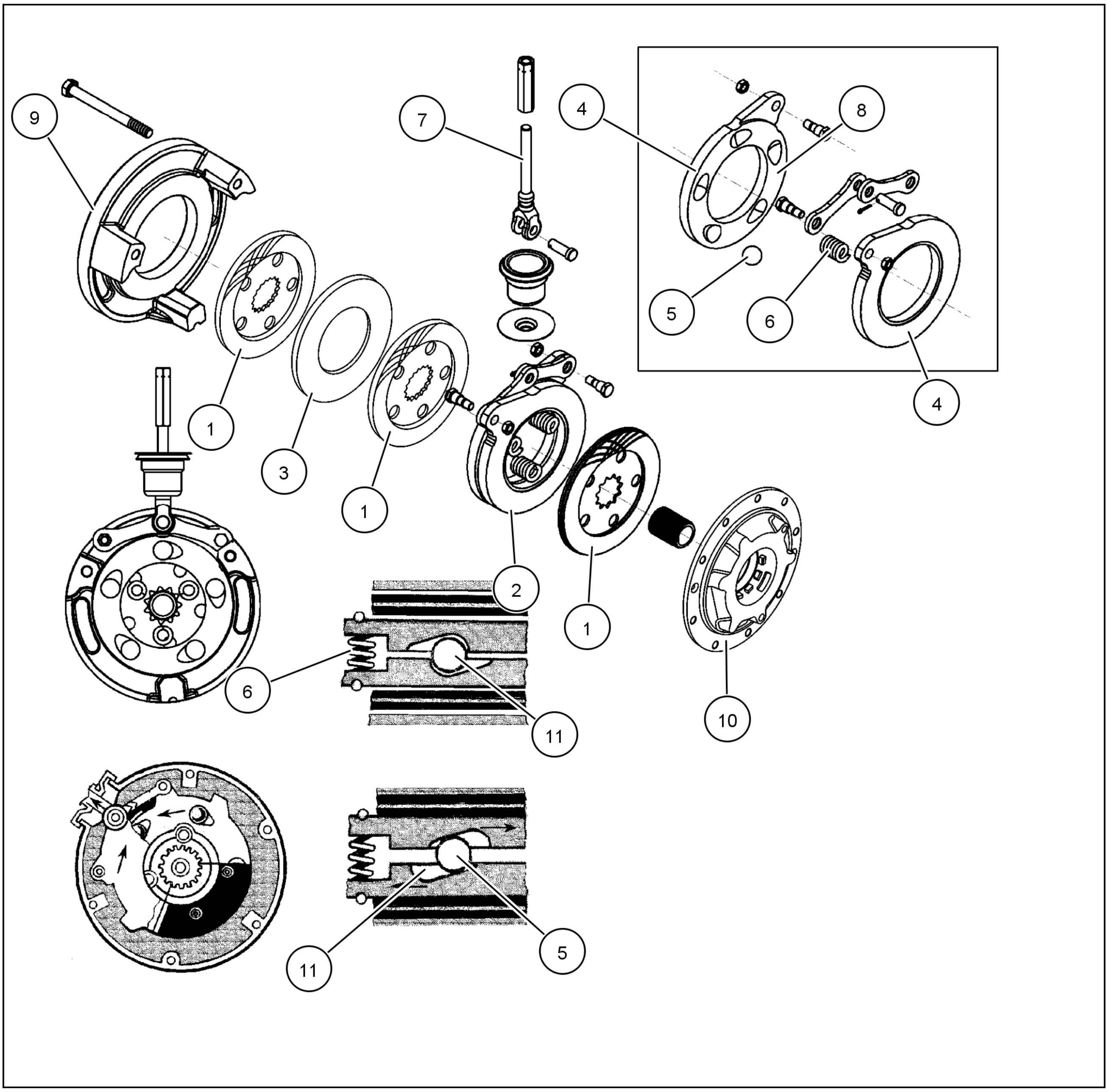
1.	Brake housing	4.	Stator
2.	Brake disc	5.	Brake support
3.	Brake actuator		

Brake - Dynamic description

Oil immersed brakes used, has three brake discs, **(1)**, both externally lined with friction material are supported by brake actuator, **(2)**, mounted on brake stator, **(3)**, An actuating assembly is mounted between the brake discs, **(1)**, which consists of two discs, **(4)**, separated by steel balls, **(5)**, but connected by short springs, **(6)**. Lugs on the discs are attached to a yoke, **(7)**, on the operating rod.



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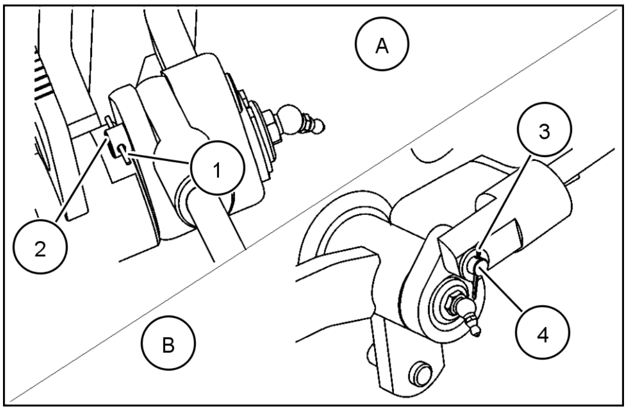
When the tractors moving, the brake discs rotate with the axle shaft. If brake pedal is depressed, its associated brake links cause this actuating discs to turn in opposite directions. As the pressure plates turn, the balls, **(5)** clamped between the actuating discs roll over the inclined surfaces of their sockets,, **(8)**. In the plates, thus causing the actuating discs to move axially outwards to contact the rotating brake discs which in turn contact the inner faces of the brake housing, **(9)**, and differential support, **(10)**, and back--up discs, **(11)**. This movement increases the axial force on the housing, support back--up disc and actuator and produce brake torque. This action causes the axle shaft, hence the associated driving wheel of the tractor, to slow down and then stop rotating completely. On release of the brake, retracting springs, **(6)**, return the plates to their original positions.

The force exerted by the driver is transmitted to the brake assembly by a system of levers and rods. The actuating system not only connects the pedal with the brake but also increases the relatively small force available at the pedal to the much larger force required to brake the vehicle. It can also permit the braking effort to be divided between the axles in the required proportion.

Left wheel brake pedal can be retained in the applied position by means of latch controlled by a hand lever fitted at right hand side, below operator’s seat used as a parking brake.

Command - Remove Brake pedals and external linkages

1. Unlock the split pin, **(1)**, and remove pin, **(2)**, on right-hand side brake linkage, **(A)**. Unlock split pin, **(3)**, from the pin, **(4)**, to remove left-hand side brake linkages, **(B)**, .



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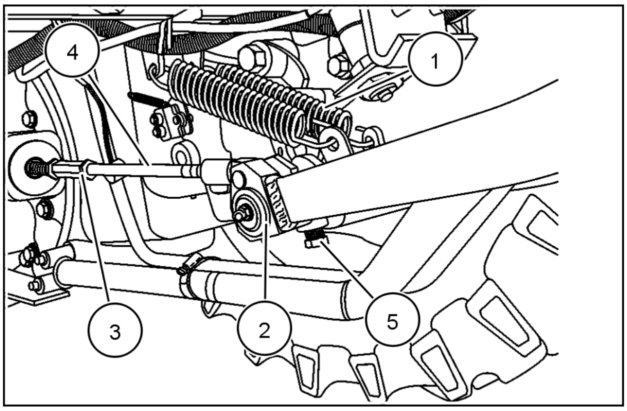
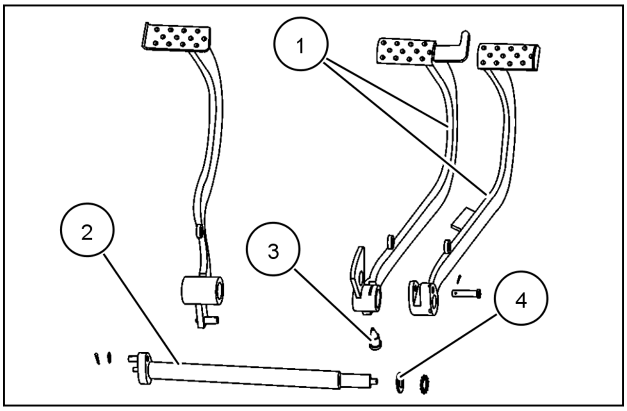
2. Remove the brake pedal springs, **(1)**.
3. Remove circlip, **(2)**, remove the locknut, **(3)**, from the sleeve rod and disconnect linkage, **(4)**, remove brake shaft locking conical screw, **(5)**.



20098833 2

4. Slide out both left-hand side and right-hand side brake pedals, **(1)**, from clutch/brake pedal support rod, **(2)**.
5. Remove conical screw **(3)** and washer, **(4)**, from support rod.



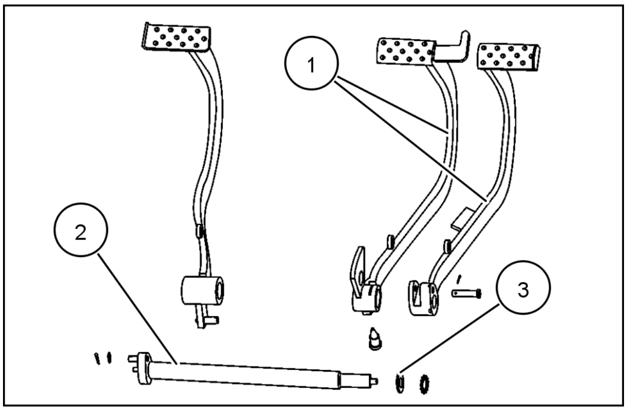
20098834 3

Next operation:
Command - Install Brake pedals and external linkages (D.30.B)

Command - Install Brake pedals and external linkages

Prior operation:
Command - Remove Brake pedals and external linkages (D.30.B)

1. Slide both the left-hand side and right-hand side brake pedals, **(1)**, onto the support shaft, **(2)**.
2. Install the washer, **(3)**, onto the support shaft, **(2)**.



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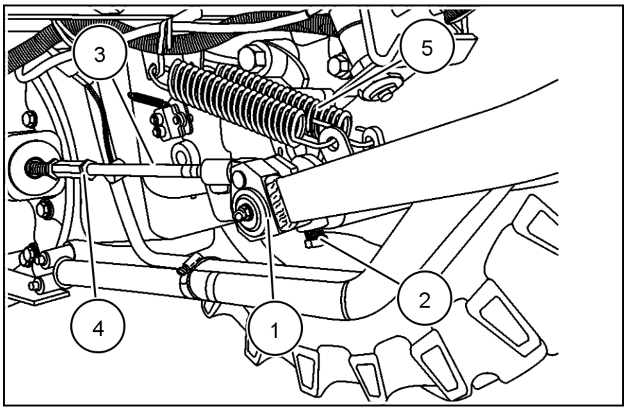
3. Install the circlip, **(1)**, onto the support shaft.
4. Install the conical screw, **(2)**, into the left brake pedal.
5. Reconnect the brake linkage, **(3)**, and tighten the jam nut, **(4)**.
6. Reconnect the brake pedal springs, **(5)**.



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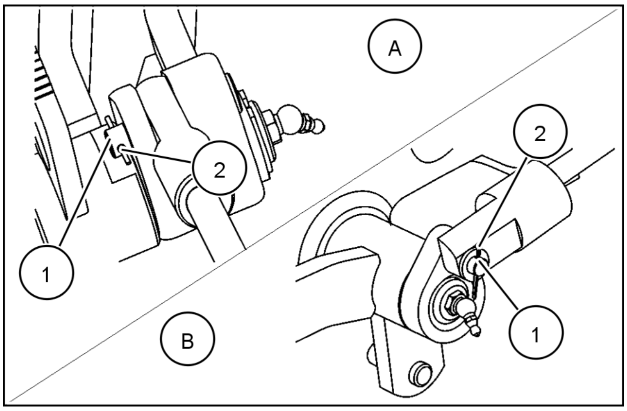
7. Attach the right-hand side, **(A)**, and left-hand side, **(B)**, brake linkages to right brake pedal and support shaft.
8. Secure using the pins, **(1)**, and cotter pins, **(2)**.

NOTE: *Check the brake pedal free play before operating tractor. Refer to:* ***Command - Adjust Free play (D.30.B)****.*



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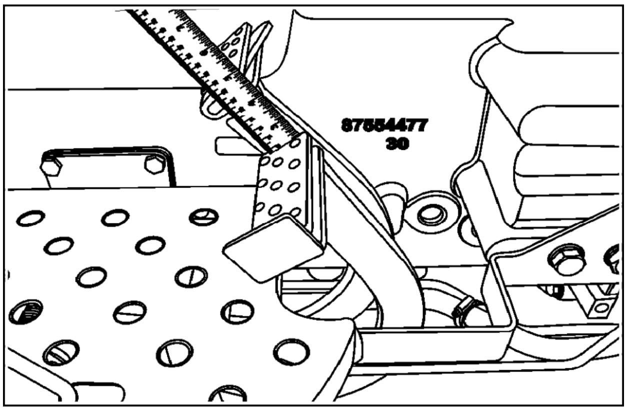
Command - Adjust Free play

Prior operation:
Brake - Assemble (D.30.B)

Measure free play of the brake pedals which should be **50 - 55 mm** (**1.97 - 2.17 in**). With the brake pedals locked together, the tractor should stop in a straight line when brakes are applied.
Adjustment is made to the brake pull rods beneath the tractor. Block the wheels , front and rear, unlock the brake pedals and release the parking brake lever. Release the locking clamp, **(1)**, loosen locknut, **(2)**, and rotate the yoke, **(3)**, clockwise to reduce the play and counterclockwise to increase the play.
Repeat the same procedure for the left brake pull rod



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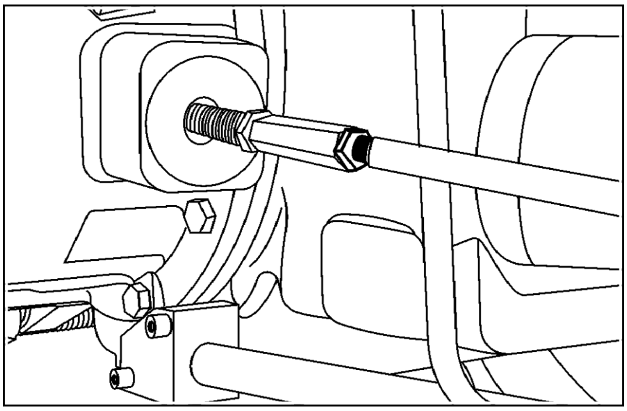
Lock the brake pedals together and road test to ensure that the brakes are balanced and will stop the tractor in a straight line. Any further adjustment necessary to balance the brakes should be carried out on the right brake.



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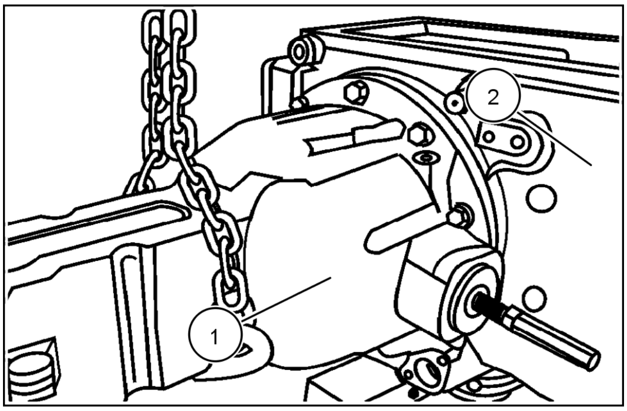
Brake - Disassemble

NOTE: *To remove brake assembly, rear axle assembly has to be removed from the transmission. Refer to* ***REAR AXLE - Remove Housing - Left-hand side or right-hand side (D.12.A)*** *for the removal of rear axle assembly.*

1. Remove rear axle housing assembly, **(1)**, from differential housing, **(2)**.



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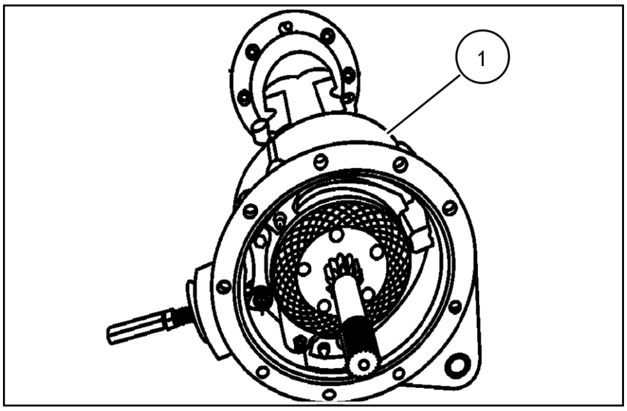
2. Place the rear axle housing assembly, **(1)**, on flat surface.

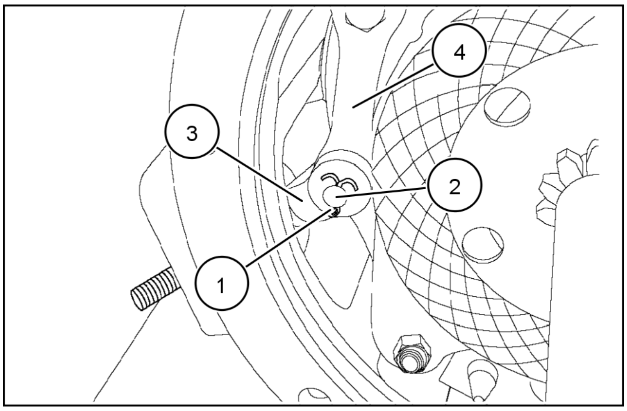


20099867 2

3. Remove the cotter pin, **(1)**, and brake rod linkage pin, **(2)**, from the rear brake rod, **(3)**, and brake actuator, **(4)**.

NOTE: *In order to remove the brake rod linkage pin, slide the brake actuator out until the pin can be removed.*

NOTE: *Push the rear brake rod out towards the front of the axle housing.*



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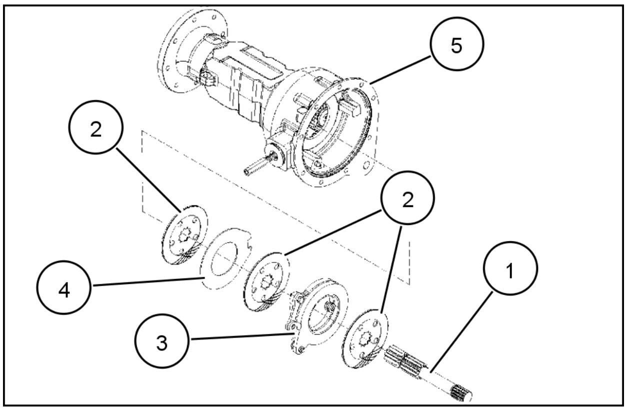
4. Pull out the differential shaft, **(1)**, along with the brake discs, **(2)**, brake actuator, **(3)**, and stator, **(4)**, from the axle housing, **(5)**.



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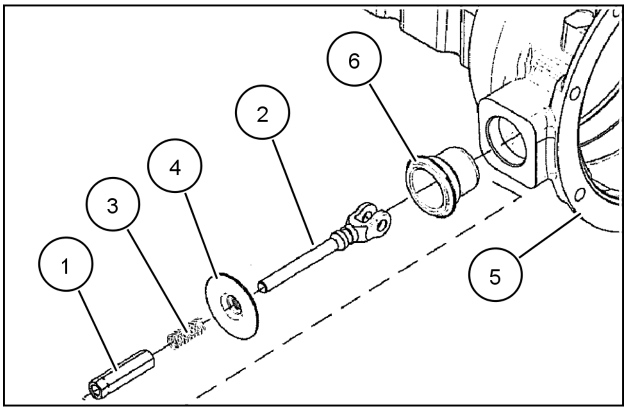
5. Unscrew the turn buckle, **(1)**, from the end of the brake rod, **(2)**.
6. Remove the spring, **(3)**, from the rear brake rod, **(2)**.
7. Remove the dust cover, **(4)**, from the brake rod, **(2)**, and remove the brake rod, **(2)**, from the axle housing, **(5)**.
8. Remove the brake rod bellow, **(6)**, from the axle housing, **(5)**.



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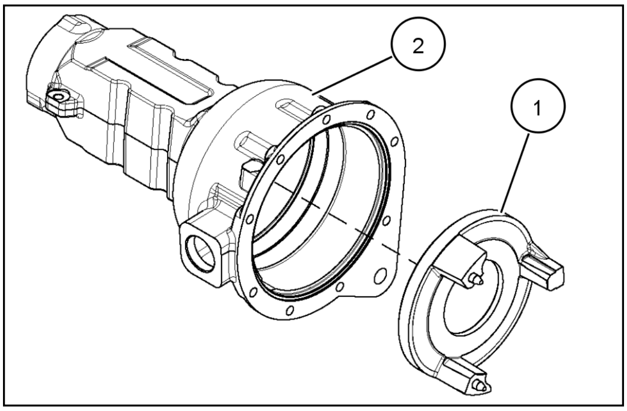
9. Remove the brake disc support, **(1)**, from the axle housing, **(2)**.

NOTE: *Dual brake assembly for low duty and heavy duty are different types.*



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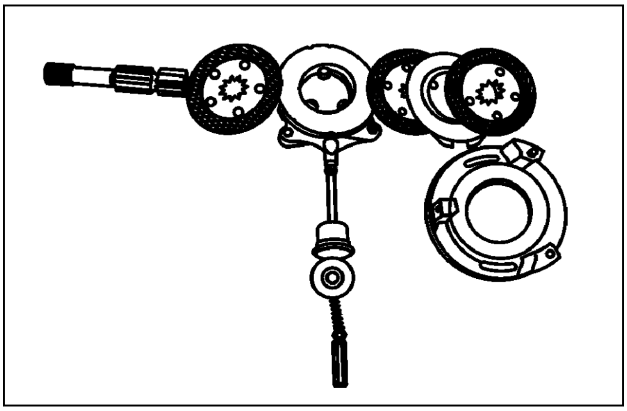
Next operation:
Brake - Inspect (D.30.B)

Brake - Inspect

Prior operation:
Brake - Disassemble (D.30.B)

1. Inspect the actuating plate faces for wear and damage, replace if necessary.
2. Inspect the brake discs, and stator if badly scored, worn, of cracked, replace.



20099871 1

NOTE: *Brake discs thickness should be a minimum of* ***4.30 mm*** *(****0.17 in****).*

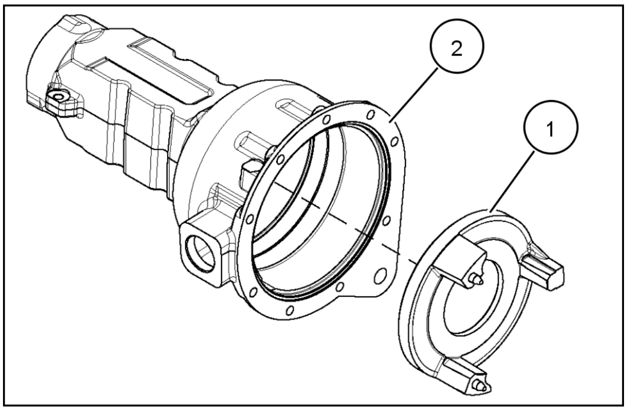
Next operation:
Brake - Assemble (D.30.B).

Brake - Assemble

Prior operation:
Brake - Inspect (D.30.B)

1. Install the brake disc support, **(1)**, into the axle housing, **(2)**.

NOTE: *The WORKMASTER 45 tractor uses a low duty brake disc support and the WORKMASTER 55 uses a heavy duty brake disc support.*



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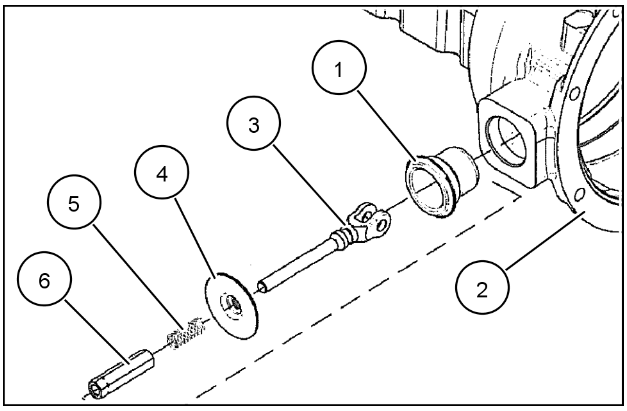
2. Install a new brake rod bellow, **(1)**, onto the axle housing, **(2)**.
3. Install the rear brake rod, **(3)**, through the rubber bellow, **(1)**, and then install the dust cover, **(4)**, onto the brake rod, **(3)**.
4. Install the spring, **(5)**, onto the rear brake rod, **(3)**.
5. Screw the turn buckle onto the end of the brake rod, **(3)**.

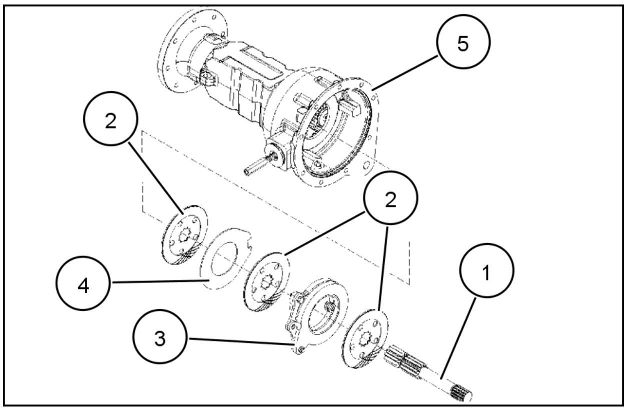


20099979 2

6. Install the brake actuator, **(1)**, brake discs, **(2)**, stator, **(3)**, and differential shaft, **(4)**, back into the axle housing, **(5)**.

NOTE: *Before installing the brake actuator, stator and brake discs, install the brake rod linkage pin to the rear brake rod.*

NOTICE: *When installing the brake actuator, stator and brake discs back into the axle housing make sure the actuator, stator and brake discs are properly aligned with the brake disc support.*

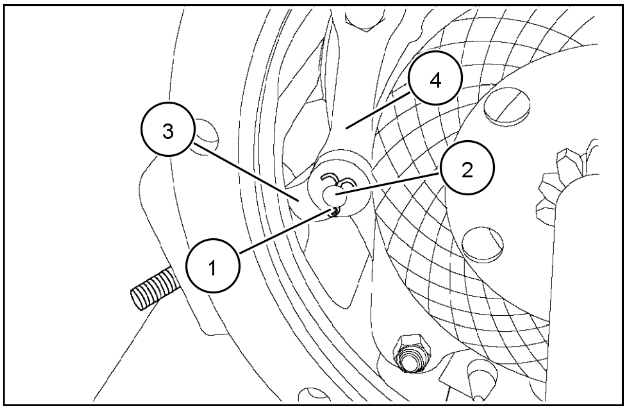


33083226 3

7. Align the rear brake rod, **(1)**, with the actuator, **(2)**, and secure using the brake rod linkage pin, **(3)**, and cotter pin , **(4)**.

NOTE: *In order to slide the brake rod linkage pin through the rear brake rod and brake actuator, the differential shaft , brake discs, stator and brake actuator will need to be pulled out from the axle housing to allow clearance.*

8. Before reinstalling the rear axle housing, thoroughly clean and degrease mating surfaces and apply a bead of liquid gasket of approximately. 2 mm of diameter following patterns shown in the Figure **5**.



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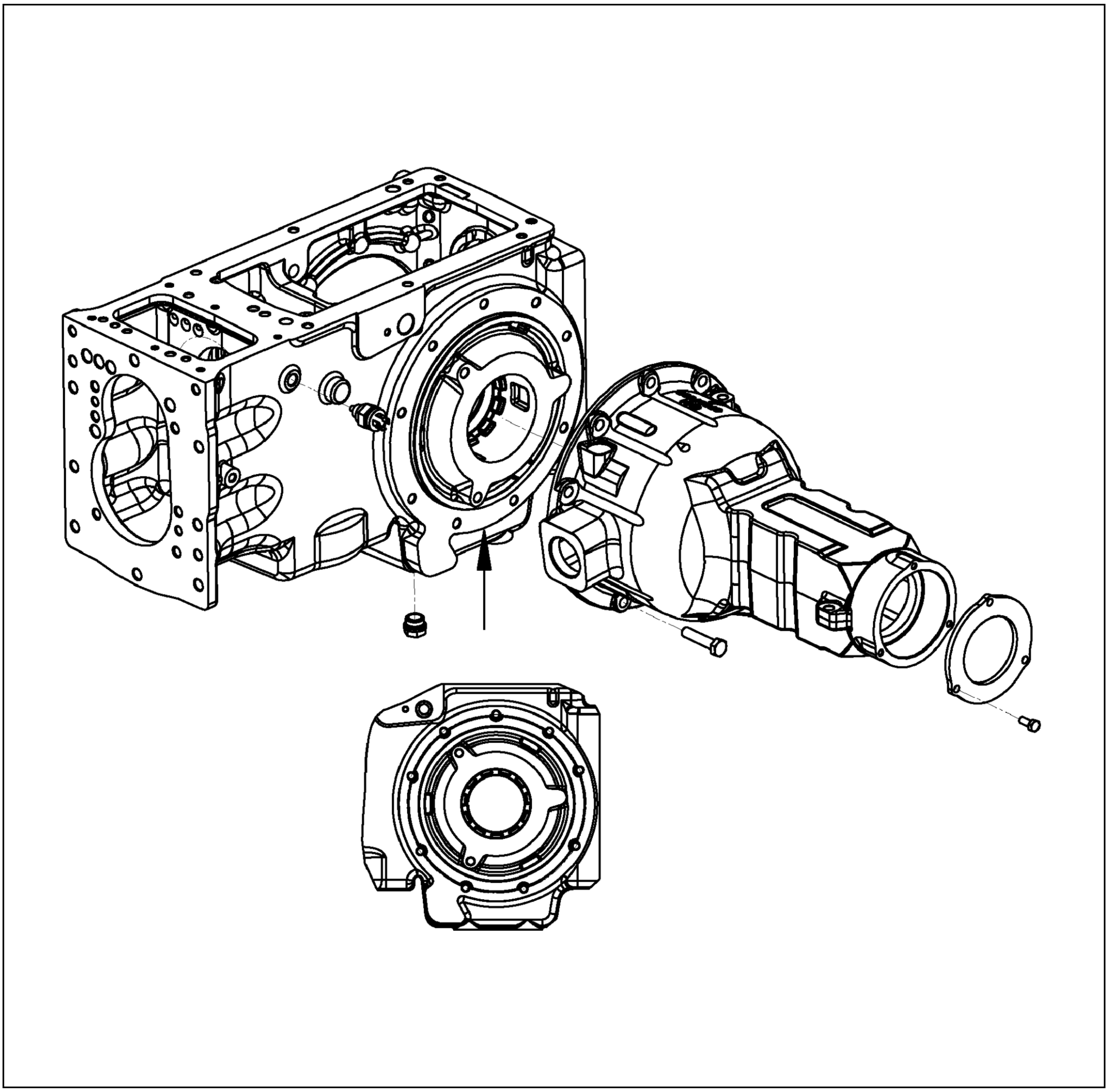
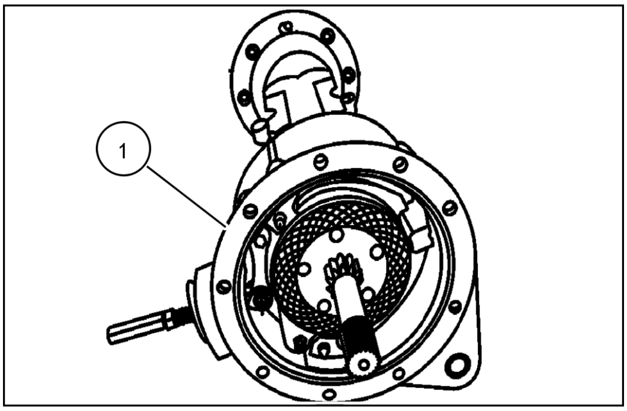


20099872 5

9. Install the axle housing assembly, **(1)**, onto the differential housing. Refer to **REAR AXLE - Install Housing - Left-hand side or right-hand side (D.12.A)**.



20099867 6

Next operation:
Command - Adjust Free play (D.30.B)

Brake - Troubleshooting

Problem	Possible Cause	Correction
Brake actuate only when pedal is depressed fully	Incorrect Pedal adjustment	Check and adjust
Tractor pulls to one side when brakes applied	Brakes not equally adjusted	Adjust
	Wrong tire pressure	Inflate tires to correct pressure
	Wrong liners on one side	Replace discs
Brakes noisy	Oil contamination	Check and change with recommended oil.
	Wrong brake disc	Replace brake discs.
Brakes remain applied when pedals are released	Seized brake actuating linkages	Clean and lubricate linkages
Pedals are hard to operate	Seized brake actuating linkages	Clean and lubricate linkages

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PARKING BRAKE Mechanical - 32.B

Workmaster 45
Workmaster 55

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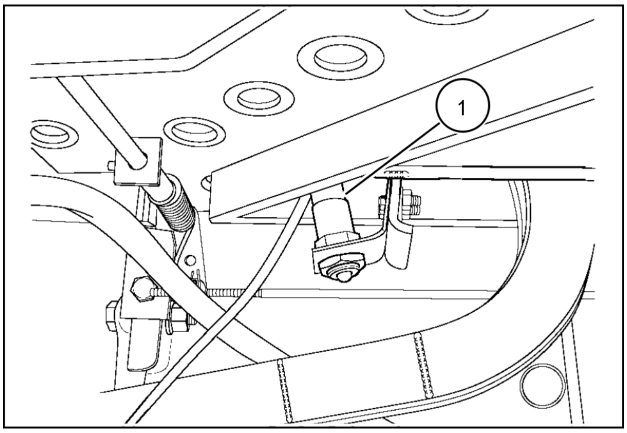
Install Park brake safety alarm - Buzzer 12

Sensing system - Static description Park brake safety switch

The park safety switch, **(1)**, is a single throw-style switch located underneath the right side platform, on the right side of the tractor. When the park brake is applied the switch closes.



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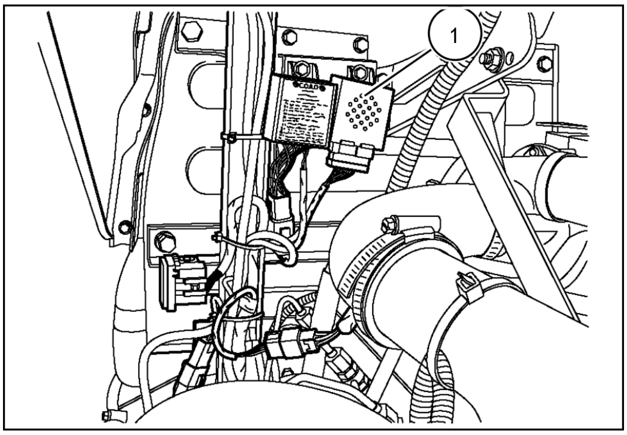
Sensing system - Static description Park brake safety alarm - Buzzer



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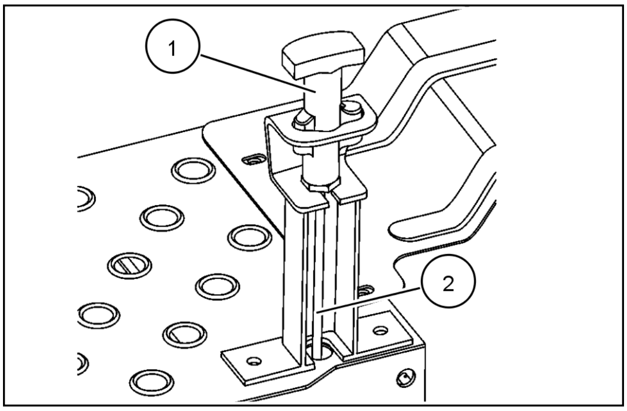
The park brake safety alarm, **(1)**, is located right side of engine compartment. The buzzer will alarm for approximately eight seconds, warning the operator when an unsafe condition occurs.

For example:

- The buzzer will alarm, with the key in the "OFF" position and the park brake disengaged.
- The buzzer will alarm, with the key in the "ON" position, with the rear PTO engaged and the park brake either engaged or disengaged.

Mechanical linkage - Remove Parking brake

1. Remove the split pin connecting the hand brake linkage to the brake pawl.
2. Pull out the hand brake lever, **(1)**, along with linkage rod, **(2)**, from the linkage assembly.



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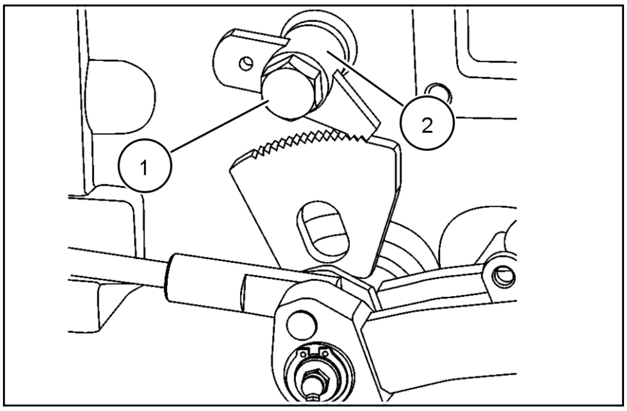
3. Loosen the bolt, **(1)**, and remove hand brake pawl, **(2)**.



20099882 2

Inspection

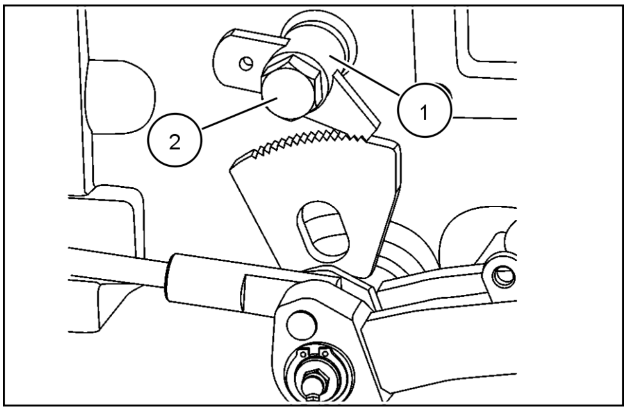
4. Clean the brake pedal assemblies thoroughly and check for bushing and support rod wear, replace as necessary.

Next operation:
Mechanical linkage - Install Parking brake (D.32.B)

Mechanical linkage - Install Parking brake

Prior operation:
Mechanical linkage - Remove Parking brake (D.32.B)

1. Install the brake pawl, **(1)**, onto differential housing and secure with M12 x 55 mm bolt, **(2)**. Torque the bolt to **80 N·m** (**59.0 lb ft**).



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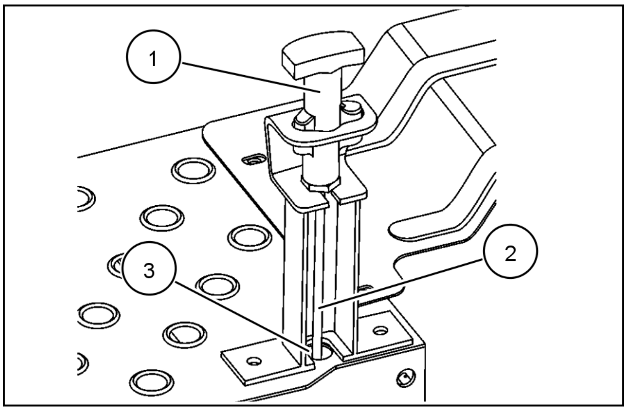
2. Insert the hand brake lever, **(1)**, along with linkage rod, **(2)**, down through the operator's platform, **(3)**.
3. Reconnect the linkage rod, **(2)**, into the hole, **(3)**, in the brake pawl, **(1)**, Figure **1**, and secure with split pin.



20098830 2

Sensing system - Test Park brake safety switch

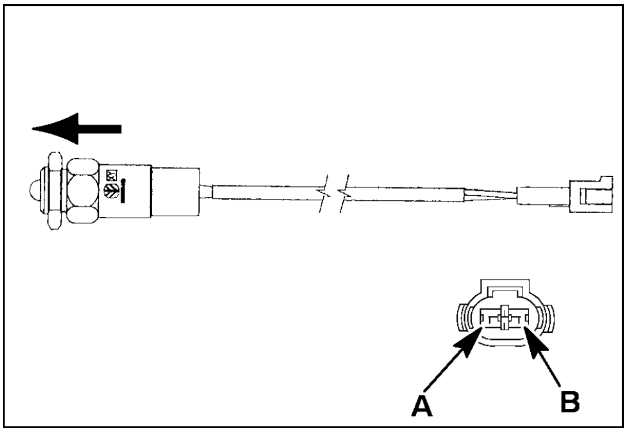
NOTE: *Use an ohmmeter to test both of the positions of the park brake safety switch for electrical continuity.*

Retracted Position (Not Shown)

1. Push the park brake safety switch into the "retracted" ("off") position, continuity should not exist. If continuity exists while the switch is in the "retracted" position, the switch is defective and needs replaced.

Extended Position

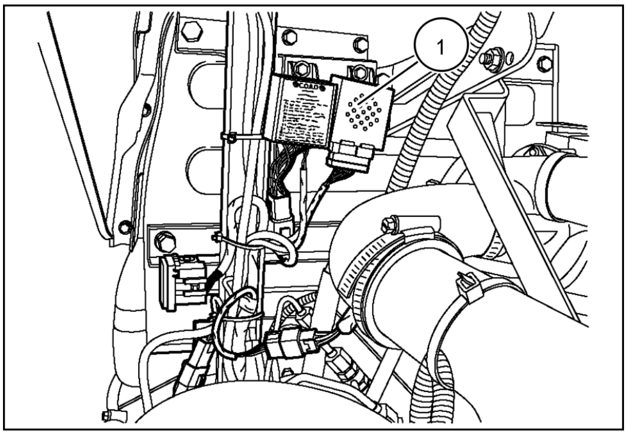
2. Using an ohmmeter, touch one of the test probes to terminal, "A". Touch the other test probe to terminal, "B". There should be continuity between terminals.



66064492 1

Sensing system - Remove Park brake safety alarm - Buzzer

1. Disconnect the negative (-) battery cable from the battery negative (-) terminal.
2. Remove the instrument panel from the dash panel.
3. Disconnect the alarm, **(1)**, from the tractor wire harness.



200900123 1

Next operation:
Sensing system - Test Park brake safety alarm - Buzzer (D.32.B)

Sensing system - Test Park brake safety alarm - Buzzer

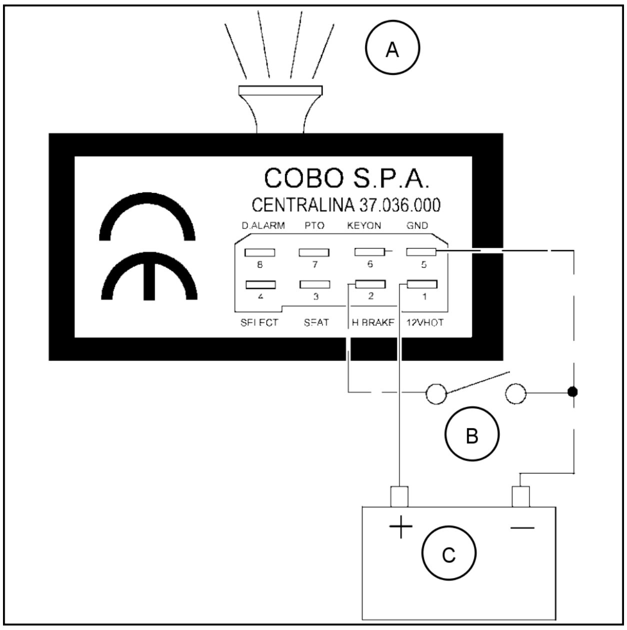
Prior operation:
Sensing system - Remove Park brake safety alarm - Buzzer (D.32.B)

NOTE: *The alarm cannot be tested with an ohmmeter.*

Condition #1

Key "OFF"
Park Brake "OFF"
Alarm "ON"

1. Connect terminal #1 to the positive (+) terminal of a **12 V** battery.
2. Connect terminal #5 to the negative (-) terminal of a **12 V** battery.
3. Install a switch between terminal #2 and negative (-) terminal of the battery.
4. When the switch is closed the alarm should be "OFF".
5. When the switch is open the alarm should be "ON".



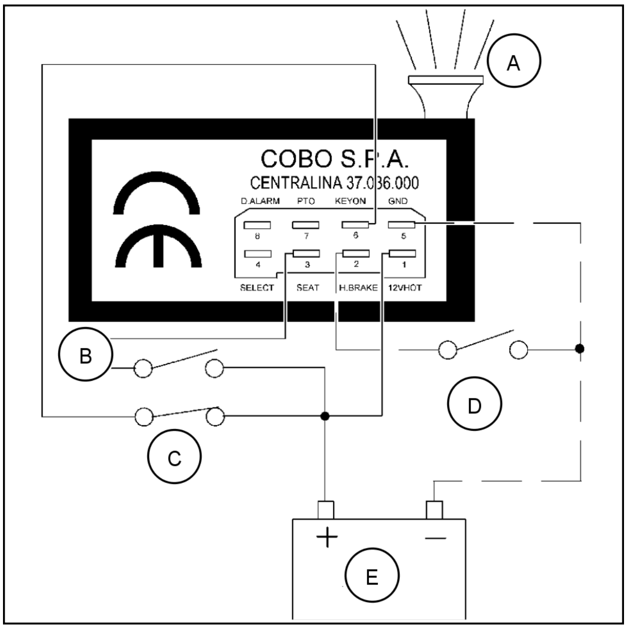
60054385 1

A - ALARM
B - PARK BRAKE SWITCH (OFF)
C - BATTERY

Condition #2

Key "ON"
Park Brake "OFF"
Operator Out of Seat
Alarm "ON"

1. Connect terminal #1 to the positive (+) terminal of a **12 V** battery.
2. Connect terminal #5 to the negative (-) terminal of a **12 V** battery.
3. Connect terminal #6 to the positive (+) terminal of the battery.
4. Install a switch (seat switch) between terminal #3 and positive (+) terminal of the battery.
5. Install a switch (park brake) between terminal #2 and negative (-) terminal of the battery.
6. When both seat and park brake switches are open the alarm should be "ON".



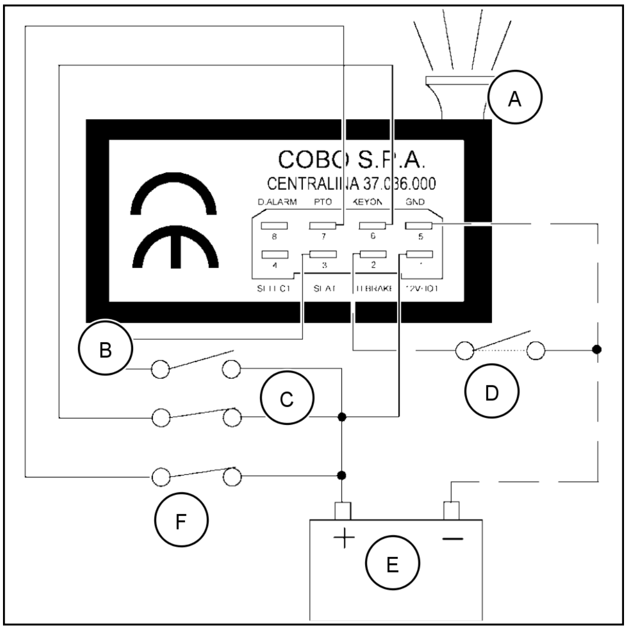
20097577 2

A - ALARM
B - SEAT SWITCH (OFF)
C - KEY SWITCH (OFF)
D - PARK BRAKE SWITCH (OFF)
E - BATTERY

Condition #3

Key "ON"
Park Brake "OFF" or "ON"
Operator Out of Seat
Rear PTO "ON"
Alarm "ON"

1. Connect terminal #1 to the positive (+) terminal of a **12 V** battery.
2. Connect terminal #5 to the negative (-) terminal of a **12 V** battery.
3. Connect terminal #6 to the positive (+) terminal of the battery.
4. Install a switch (seat switch) between terminal #3 and positive (+) terminal of the battery.
5. Install a switch (park brake) between terminal #2 and negative (-) terminal of the battery.



20097578 3

A - ALARM
B - SEAT SWITCH (OFF)
C - KEY SWITCH (OFF)
D - PARK BRAKE SWITCH (OFF)
E - BATTERY
F - REAR PTO (ON)

6. Install a switch (rear PTO) between terminal #7 and positive (+) terminal of battery.
7. Open both seat and park brake switches.
8. Close rear PTO switch between terminal #7 and positive (+) battery terminal.
9. With the seat and park brake switches open and rear PTO switch closed the alarm should be "ON".

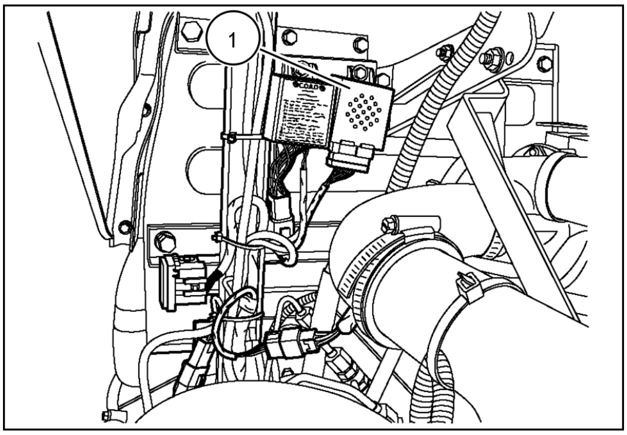
NOTE: *If any of the above tests do not perform with the expected results, replace the alarm.*

Next operation:
Sensing system - Install Park brake safety alarm - Buzzer (D.32.B)

Sensing system - Install Park brake safety alarm - Buzzer

Prior operation:
Sensing system - Test Park brake safety alarm - Buzzer (D.32.B)

1. Connect alarm, **(1)**, to the tractor wire harness.
2. Install the instrument panel into the dash panel.
3. Connect the negative (-) battery cable to the battery negative (-) terminal.



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SERVICE - Technical Publications & Tools

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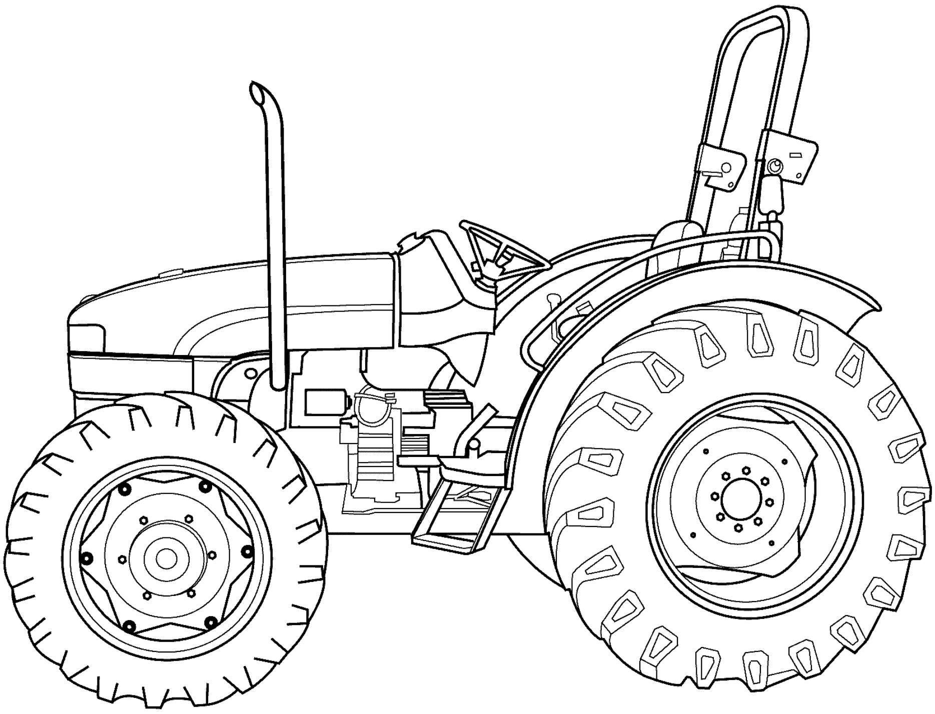
SERVICE MANUAL

FRAME AND CAB



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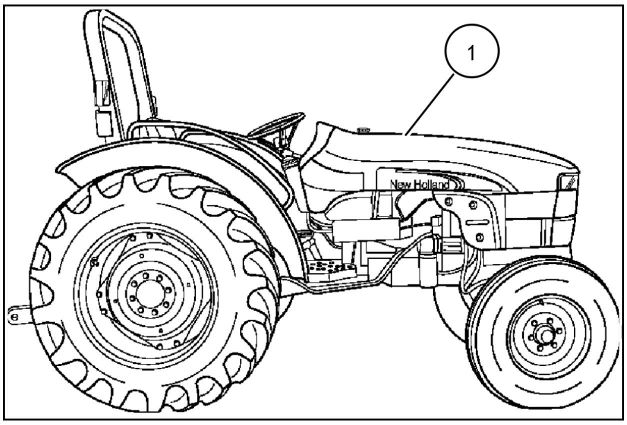
Engine hood - Remove PANEL ASSEMBLY

1. Unlatch and raise the hood panel, **(1)**.
2. Disconnect the headlamp harness from the headlamp assemblies, and from the clamps that run along inside the right side of the hood panel.
3. Support the hood panel with a suitable hoist or sling. When a hoist or sling is not available, enlist the help of several people to hold the hood panel while detaching.



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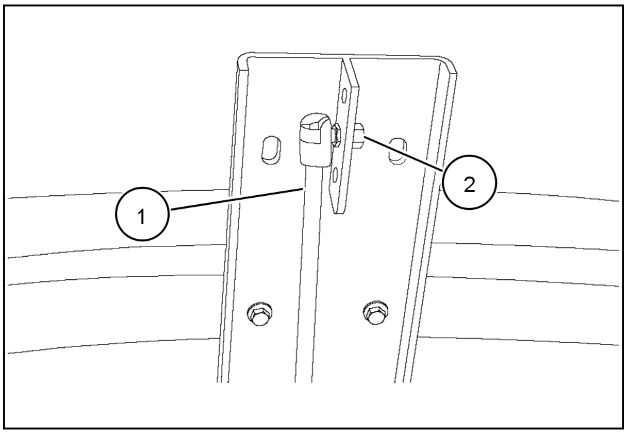
⚠ WARNING ⚠

Lift and handle all heavy components using lifting equipment of appropriate lifting capacity. Ensure that units or parts are supported by suitable slings or hooks. Ensure that no persons or pets are in the vicinity of the load to be lifted. Failure to comply could result in death or serious injury.

M1258

4. Disconnect the strut, **(1)**, at the actuator rod-end, **(2)**, where it attaches to the hood panel.



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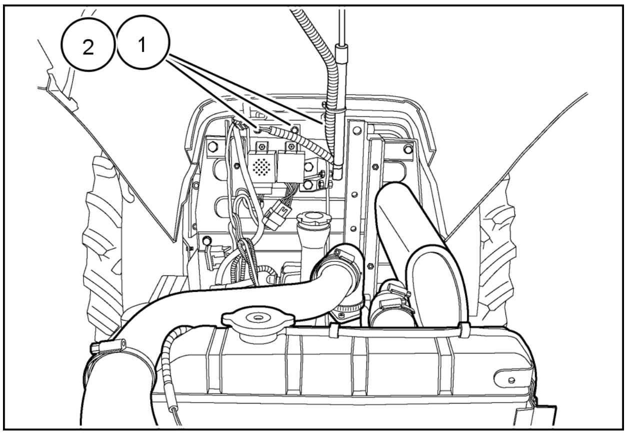
5. Remove the M8 x 30 mm bolts, **(1)**, and M8 lock washers, **(2)**, securing hood to tractor.



86071910 3

⚠ WARNING ⚠

Lift and handle all heavy components using lifting equipment of appropriate lifting capacity. Ensure that units or parts are supported by suitable slings or hooks. Ensure that no persons or pets are in the vicinity of the load to be lifted. Failure to comply could result in death or serious injury.

M1258

6. Carefully lift the hood from tractor, and place on firm level ground, using care not to damage.

Next operation:
Engine hood - Install PANEL ASSEMBLY (E.20.A)

Engine hood - Install PANEL ASSEMBLY

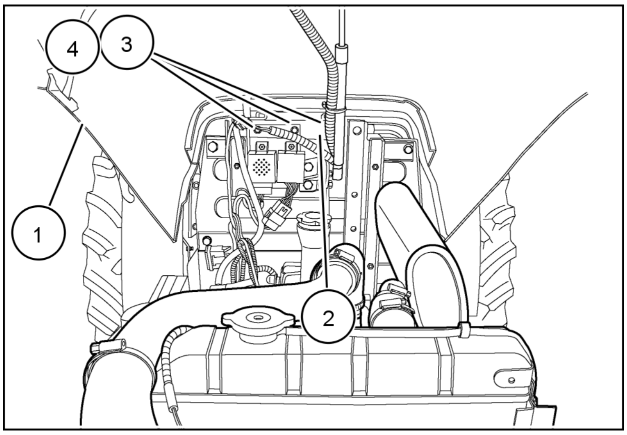
Prior operation:
Engine hood - Remove PANEL ASSEMBLY (E.20.A)

⚠ WARNING ⚠

Lift and handle all heavy components using lifting equipment of appropriate lifting capacity. Ensure that units or parts are supported by suitable slings or hooks. Ensure that no persons or pets are in the vicinity of the load to be lifted. Failure to comply could result in death or serious injury.

M1258

1. Carefully lower the hood, **(1)**, onto tractor, while aligning holes in the mounting bracket, **(2)**.
2. Re-insert the M8 x 30 mm bolts, **(3)**, and M8 lock washers, **(4)**, securing the hood to the tractor.



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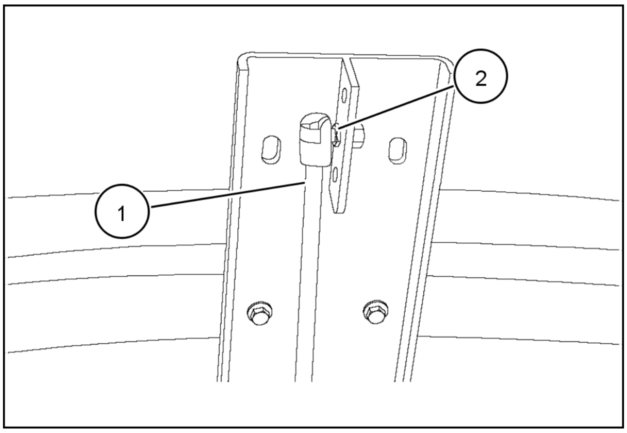
3. Reconnect the strut, **(1)**, to the actuator rod end, **(2)**, where it attaches to the hood panel.
4. Reconnect the headlamp harness, and check for proper operation of high and low beams.
5. Carefully close and open the hood panel to verify proper operation of the strut, **(1)**.
6. Inspect the headlamp harness, to make sure it does not come in contact with any hot or moving parts in the engine compartment.



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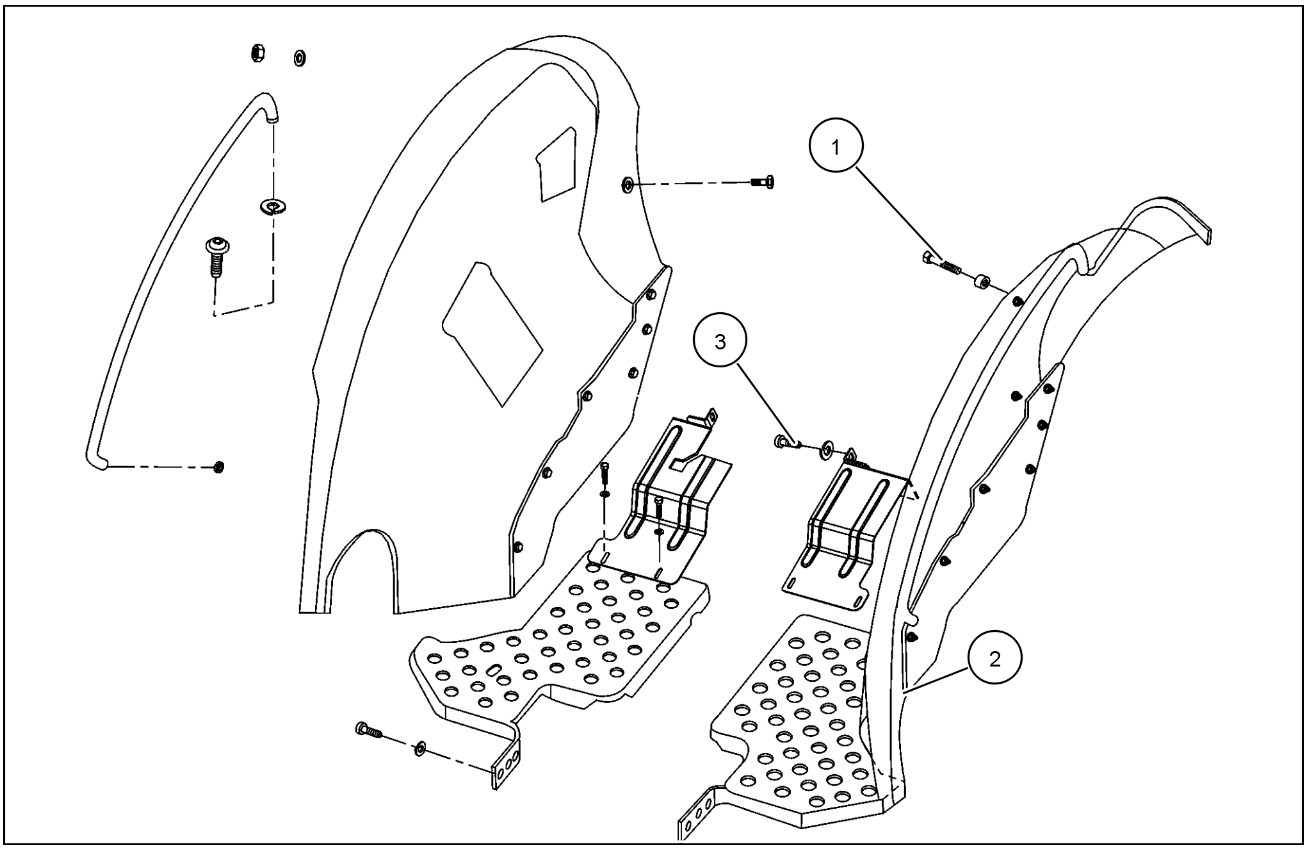
Protective shield - Remove REAR WHEEL FENDERS



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1. Remove the mounting bolts, washers and nuts, **(1)**, that secure the right or left rear fender to the ROPS.
2. Remove the bolts and nuts, **(2)**, that attach the forward edge of the fender to the platform.

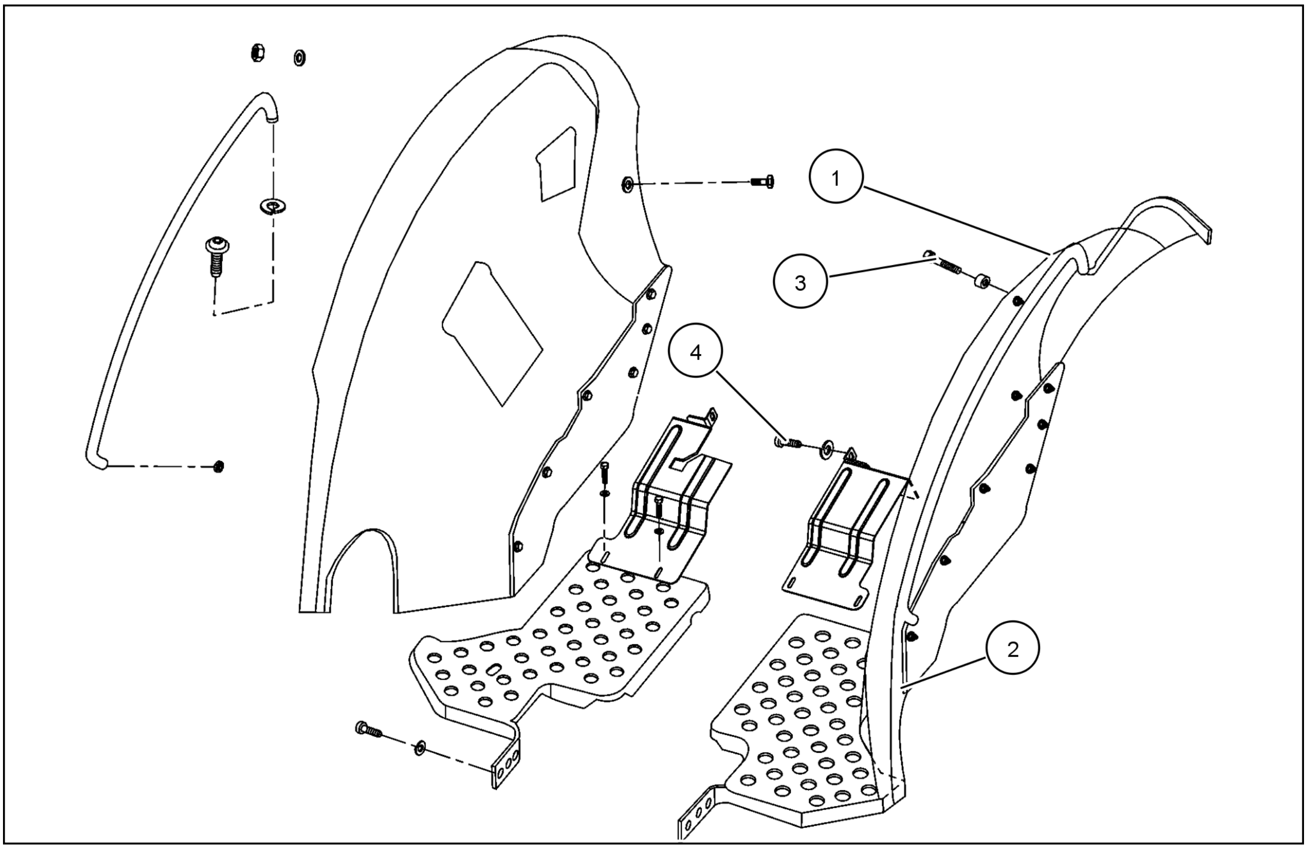
NOTE: *Pay close attention to placement of hardware during removal, to ensure proper placement during assembly procedure.*

3. Remove the bolts and nuts, **(3)**, that attach the right-hand side fender to the footboard extension plate.

Next operation:
Protective shield - Install REAR WHEEL FENDERS (E.20.A)

Protective shield - Install REAR WHEEL FENDERS

Prior operation:
Protective shield - Remove REAR WHEEL FENDERS (E.20.A)



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NOTE: *When installing a rear fender, always ensure that no contact exists between the fender and the tire. Damage may occur to the fender or tire from chaffing.*

1. Place the fender, **(1)**, into position on tractor.
2. Reinstall the bolts and nuts, **(2)**, that secure the front edge of the fender to the platform.
3. Reinstall the mounting bolts, washers and nuts, **(3)**, that secure the right or left side fenders to the ROPS.
4. Reinstall the bolts and nuts **(4)**, that secure the right hand side fender to the footboard extension plate.
5. Tighten all bolts and nuts.

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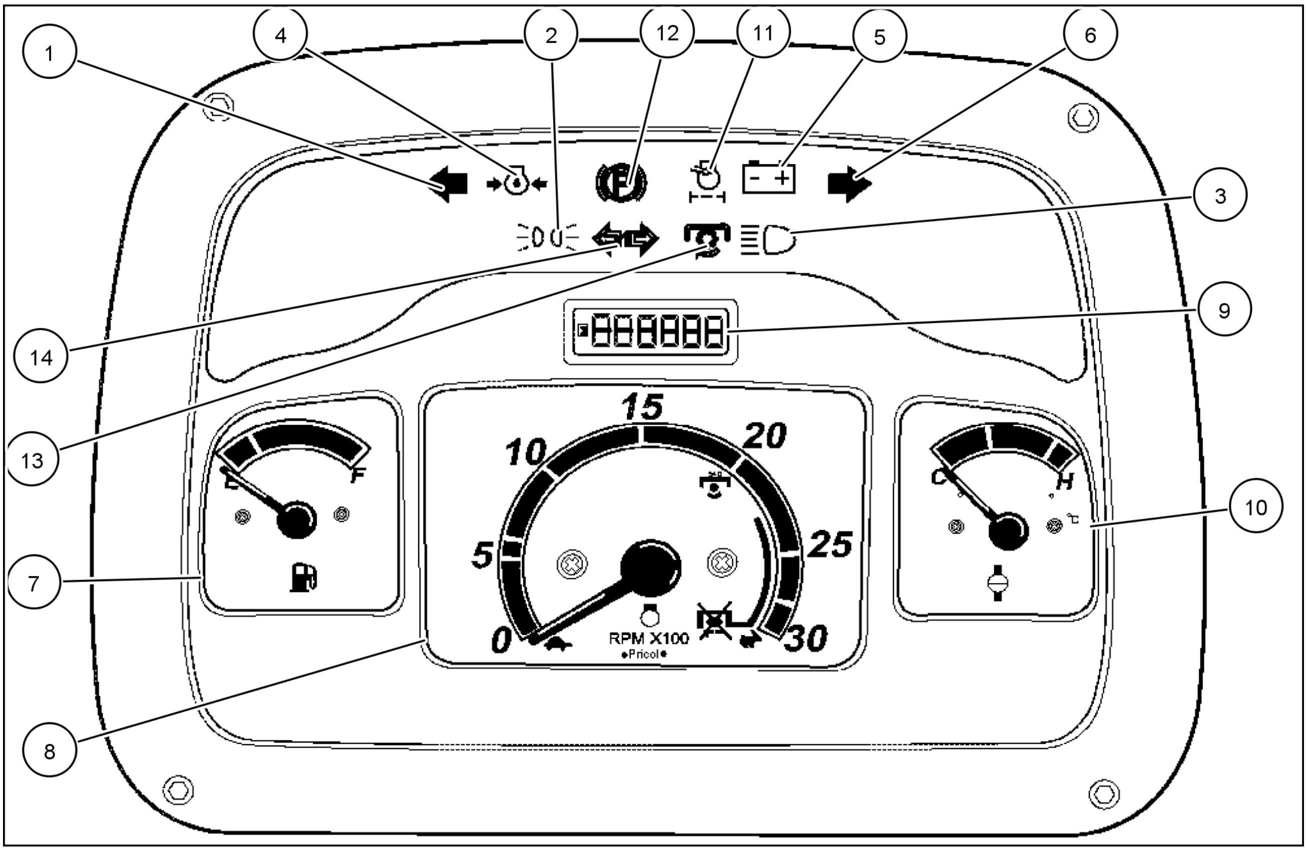
Instrument panel - Static description

The instrument panel is serviced as assembly, if any component is faulty, replace the instrument panel.

The warning and illumination light bulbs are serviced separately:

- Warning lights **1.7 W** bulb
- Illumination lights **3.0 W** bulb



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INSTRUMENT PANEL, GAUGES, AND WARNING LIGHTS

The instrument panel, Figure **1**, comprises Three gauges and seven colored lights, which provide operating information or give warning of system malfunction.

The instruments are illuminated when key start switch is turned to "on" position.

Left Turn Indicator

The blinking GREEN light, **(1)**, indicates the direction of turning to left hand side. Green light will flash in unison with tractor left hand turn signal.

Position Lights

With the key-start switch on a GREEN light, **(2)**, indicates that the position lights are on.

⚠ WARNING ⚠

Never exit the machine without first confirming the parking brake is set. Failure to comply could result in death or serious injury.

M1115A

Head Light High Beam Indicator Light

The BLUE light, **(3)**, will be illuminated when the tractor lights are switched to high beam.

Engine Oil Pressure

Steady light, **(4)**, in the middle indicates low engine oil pressure. Stop the engine and investigate the cause.

Battery Charging Indicator

The battery symbol, **(5)**, glows when the alternator is not charging the battery.

Right Turn Indicator

The blinking GREEN light, **(6)**, indicates the direction of turning to right hand side. Light will flash in unison with tractor right hand turn signal.

Fuel Gauge

The gauge, **(7)**, indicates the level of the fuel in the tank and is only operative with the key start switch turned on to position - 2.

Tachometer

The tachometer, **(8)**, indicates engine revolutions per minute (rpm). Each division on the scale represents **100 RPM** therefore with the needle indicating ’20’ the engine is running at ’ **2000 RPM**’ .

A PTO symbol on the rpm scale indicates the engine speed at which the standard PTO speed of **540 RPM** at **1967 engine RPM** is obtained.

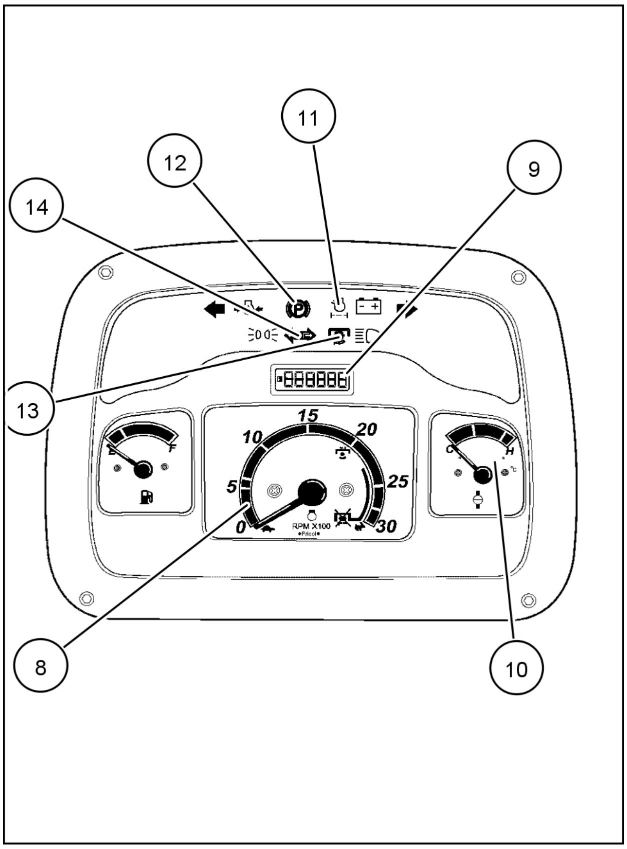
Hour Meter

The reading of the Hour Meter, **(9)**, indicates the hours the tractors has run.

Water Temperature Gauge

The gauge, **(10)**, indicates the temperature of the engine coolant. If the needle enters the right-hand (red) section of the gauge while the engine is running, bring the engine to idle rpm and run for some time before switching off the engine to investigate the cause.

When the engine is switched off, the gauge needle will assume an initial position.



20099048A 2

Parking Brake Indicator Light

Glowing of the parking brake indicator light, **(12)**, indicates the parking brake engaged.

Air Cleaner Restriction Light

Glowing of the air cleaner restriction light, **(11)**, indicates that air cleaner is clogged. Clean the air cleaner outer element whenever light glows.

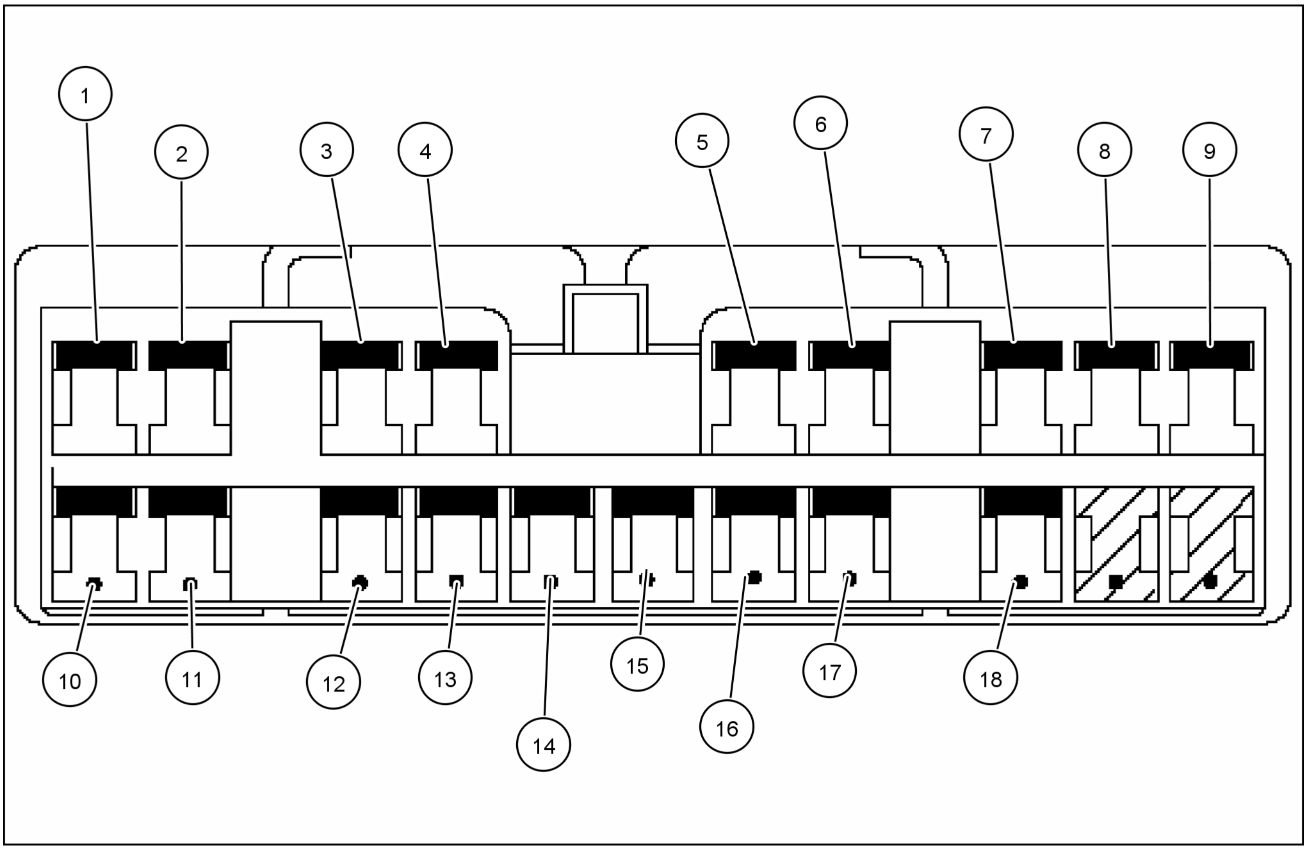
PTO Indicator Light

Glowing of the PTO indicator light, **(13)**, indicates the PTO is engaged.

Trailer Turn Indicator

The GREEN light, **(14)**, will blink when a trailer is connected to the trailer socket and the left or right turn indicator is activated. Not applicable in North America.

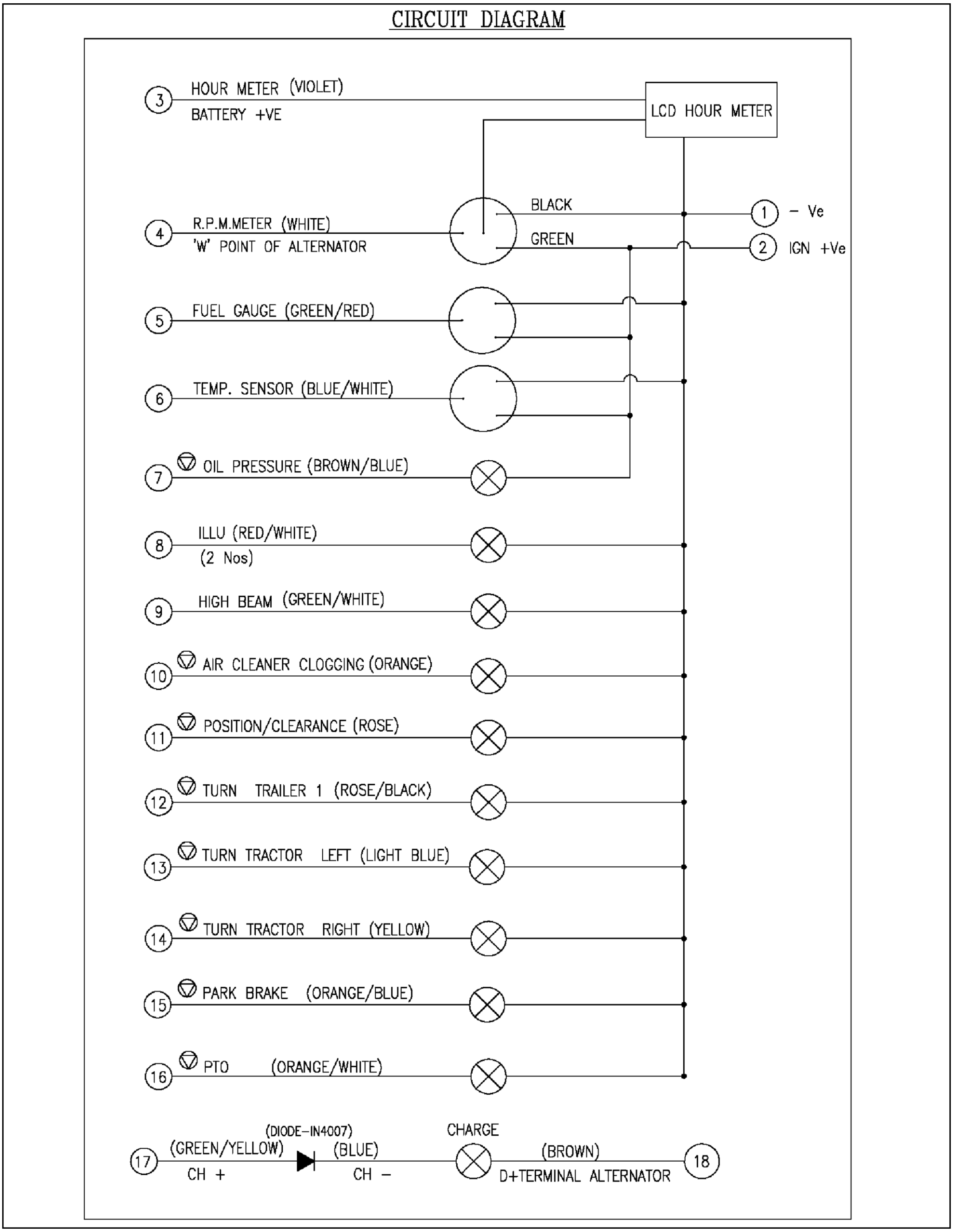
Instrument panel - Component identification Instrument Panel Master Plugs Identification



20099116 1

1.	Ground	10.	Air cleaner restriction warning light (+)
2.	+ **12 V** (switched)	11.	Position Lights Indicator (+)
3.	+ **12 V** (unswitched)	12.	Trailer Lights (+)
4.	Tachometer incoming from alternator lead (+)	13.	Left turn signal (+)
5.	Fuel Gauge from sender (-)	14.	Right Turn Signal (+)
6.	Coolant Temperature Gauge from sender (-)	15.	Parking brake
7.	Engine Oil Pressure from sender (-)	16.	PTO
8.	Illumination (+)	17.	Charge indicator light (+)
9.	High Beam Indicator (+)	18.	Charge Indicator light (-)

Instrument panel - Functional diagram

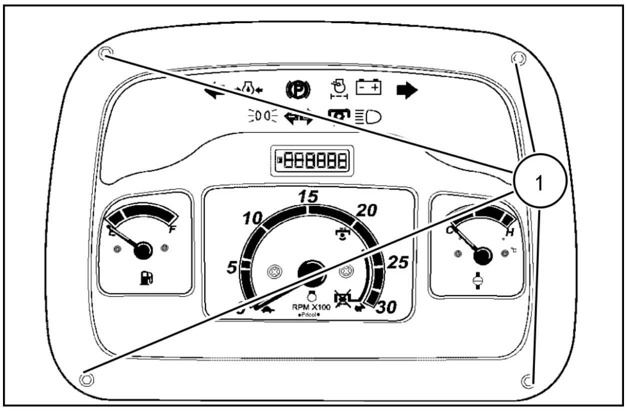


20099114 1

Instrument panel - Remove

Prior operation:
Instrument panel - Static description (E.32.A)

1. Remove the screws, **(1)**, and pull the instrument panel out from the front of the top console.
2. Disconnect the wire harness connectors and remove instrument panel from the tractor.



20099049A 1

Next operation:
Instrument panel - Electrical test (E.32.A)

Instrument panel - Electrical test

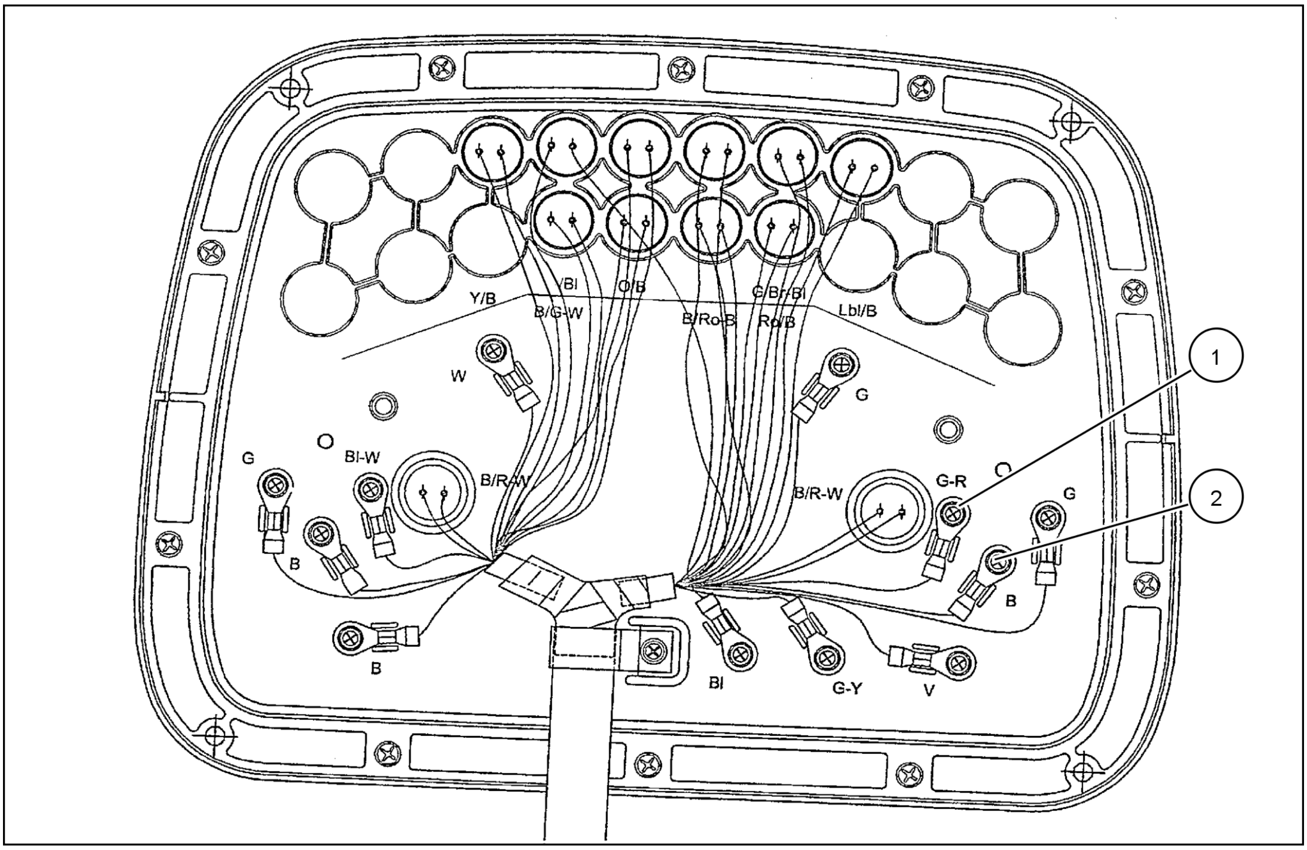
Prior operation:
Instrument panel - Remove (E.32.A)

Fuel Gauge

Measuring across terminals "GR" and "B" with the fuel sender at the following amounts. (With key switch in the "OFF" position)

Indication	Empty (Start of Red Band)	Full
Resistance (ohms)	**148 Ω**((± **6 Ω**)	**10 Ω** (± **4 Ω**)

With the key switch in the "ON" position you should receive **12 V** across terminals "G" and "B".



20099111 1

1. Terminal “GR”
2. Terminal “B”

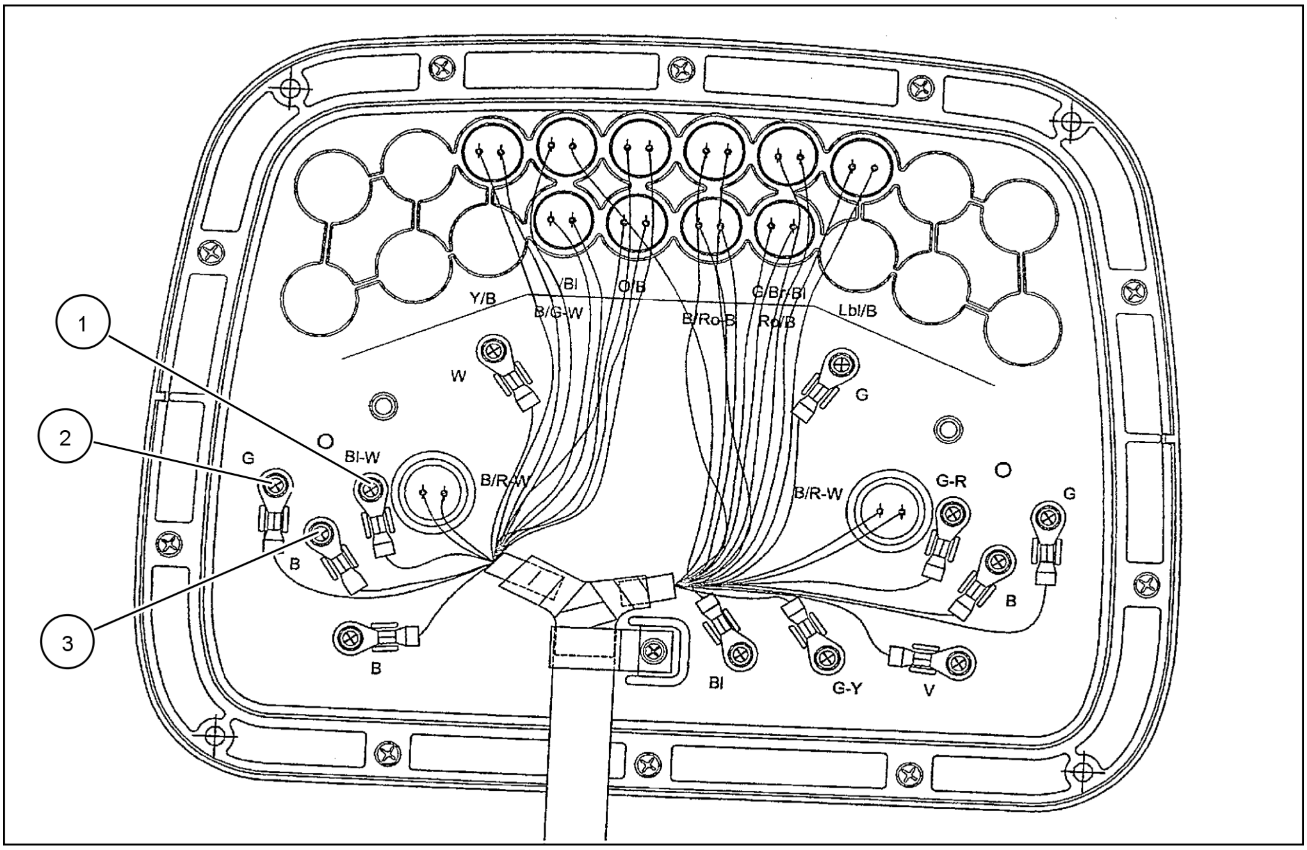
Temperature Gauge

Measuring across terminals "BL - W" and "B" with the coolant temperature at the following amounts. (Key switch in "OFF" position)

Temperature	**50 °C** (**122.0 °F**)	**80 °C** (**176 °F**)	**110 °C** (**230 °F**)
Resistance (ohms)	**154 Ω**	**51.98 Ω**	**21.1 Ω**
Tolerance in angle	-	(**± 3.5 °**)	(**± 3.5 °**)

With the key switch in the "ON" position you should receive **12 V** across terminals "G" and "B"

Color Zone to Temperature Relationship	
1st Green Zone	**50 - 80 °C** (**122 - 176 °F**)
2nd Green Zone	**80 - 110 °C** (**176 - 230 °F**)
Red Zone	**110 - 120 °C** (**230 - 248 °F**)

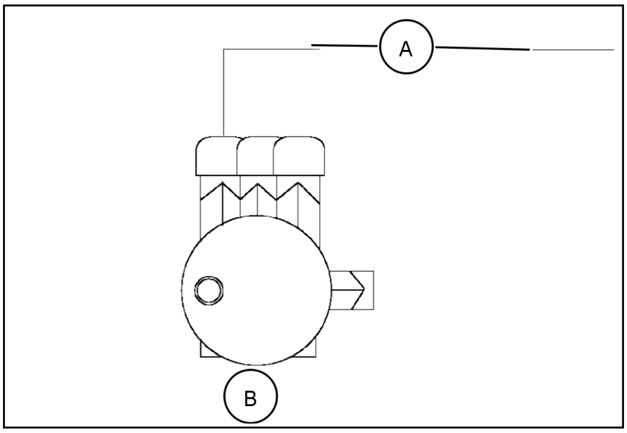


20099111 2

1. Terminal “GR”
2. Terminal “G”
3. Terminal “B”

Tachometer

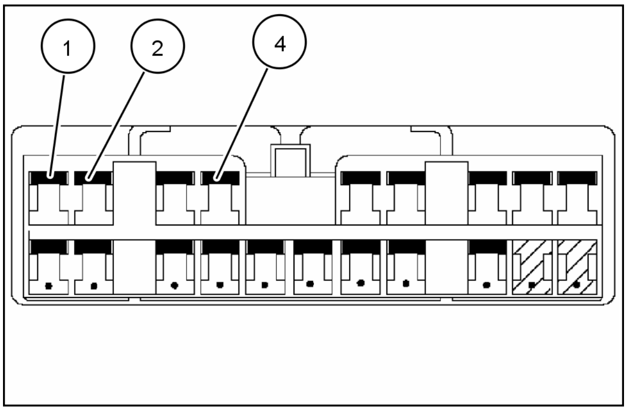
The tachometer receives a signal from the RT12 terminal of the alternator, when the alternator is rotating.
Wire color code HMP1 YG - 0.5 (Yellow/Green)



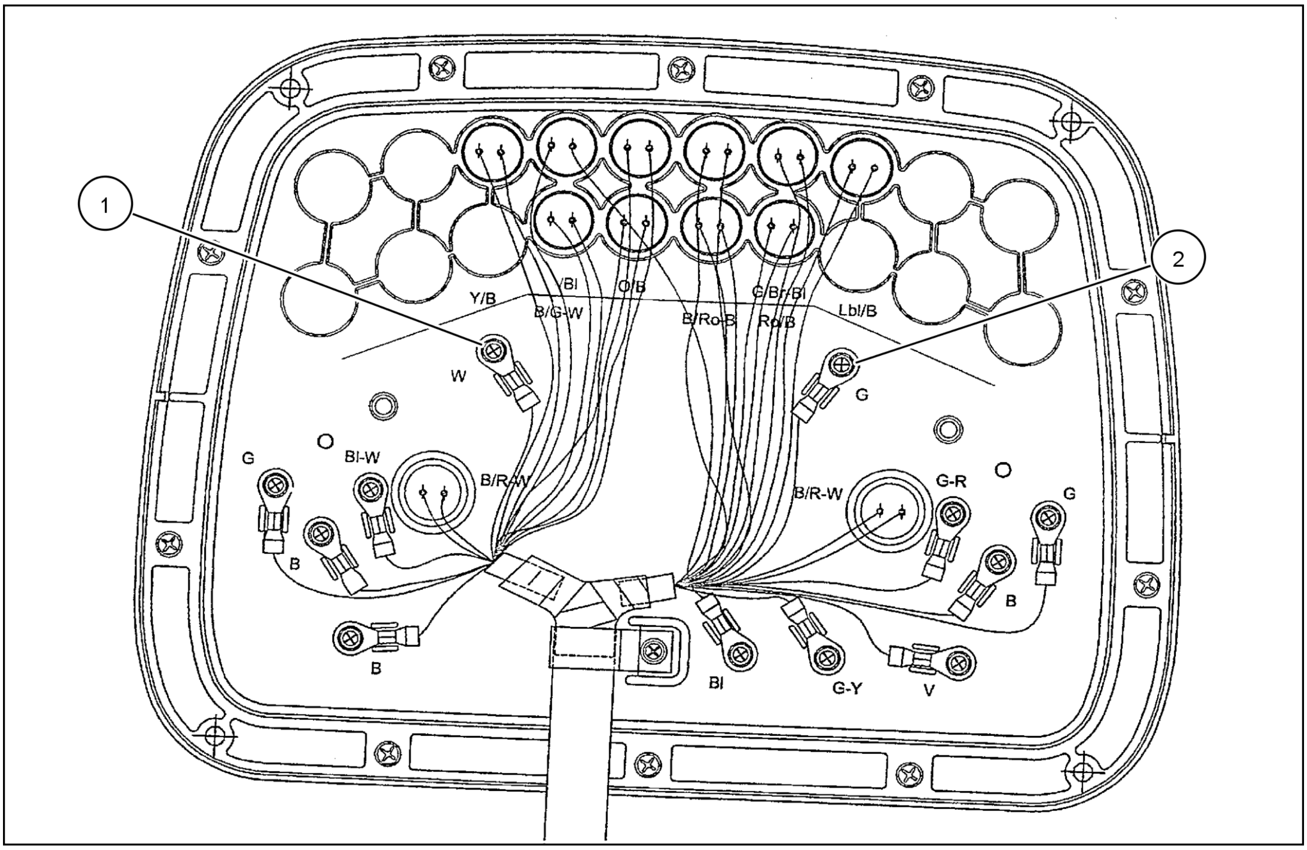
20097588 3

A - HMPI YG - 0.5
B - ALTERNATOR

Terminal **(4)** (small connector) white wire, is the input (from the alternator) to the tachometer, terminal **(1)** is the ground and terminal **(2)** is the switched power lead.



20099115 4



20099111 5

1.	Terminal “W”	2.	Terminal “G”

Check for current at terminals **(4)** and **(2)** when the engine is running also terminals "W" and "G" on the back of the instrument panel. If current is present and the tachometer still does not register a rpm reading replace the instrument panel. If the rpm reading is erratic, check fan belt tension.

Next operation:
Instrument panel - Component identification Instrument Panel Master Plugs Identification (E.32.A)

Instrument panel - Troubleshooting

Problem	Possible Cause	Correction
Warning lights and gauges inoperative	Blown #6 **15 A** fuse.	Replace fuse.
Gauges erratic or inoperative	Faulty ground circuit.	Check ground connections for proper contact.
	Faulty sender.	Check sender for proper operation.
Warning lights not illuminating	Bulb is burned out	Replace bulb
	Sender wire damaged	Check wiring harness for damage
	Faulty sender	Check sender for proper operation
Gauges always show maximum reading	Sender wire shorted to ground.	Check sender wire for damage.
Erratic tachometer reading	Fan belt slipping.	Tighten fan belt.

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USER PLATFORM - 34.A

Workmaster 45
Workmaster 55

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USER PLATFORM - 34.A

SERVICE

ROPS

Remove ROLL-OVER PROTECTION BAR 3

Install ROLL - OVER PROTECTION BAR 4

ROPS - Remove ROLL-OVER PROTECTION BAR

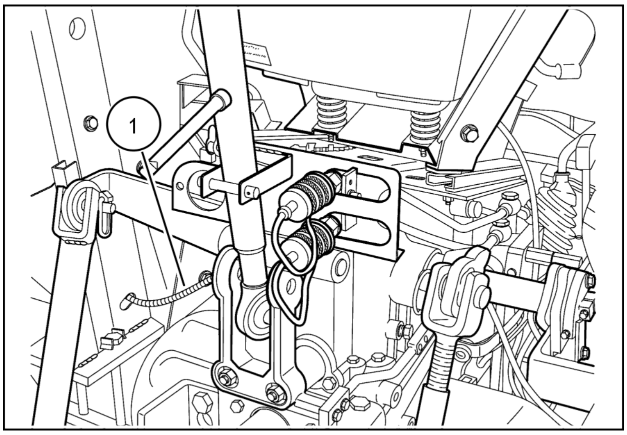
Prior operation:
Protective shield - Remove REAR WHEEL FENDERS (E.20.A)

⚠ WARNING ⚠

Lift and handle all heavy components using lifting equipment of appropriate lifting capacity. Ensure that units or parts are supported by suitable slings or hooks. Ensure that no persons or pets are in the vicinity of the load to be lifted. Failure to comply could result in death or serious injury.

M1258

1. Support the ROPS with a suitable hoist or sling.
2. Disconnect the light harness, **(1)**.



20099861 1

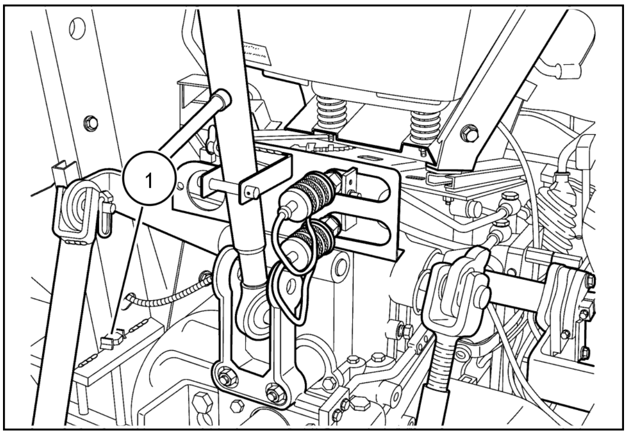
3. Remove the M16 nuts, M16 belleville washers and M16 x 200 mm bolts, **(1)**, that attach the ROPS to the axle housing. Do not allow the ROPS to fall.

⚠ WARNING ⚠

Lift and handle all heavy components using lifting equipment of appropriate lifting capacity. Ensure that units or parts are supported by suitable slings or hooks. Ensure that no persons or pets are in the vicinity of the load to be lifted. Failure to comply could result in death or serious injury.

M1258

4. Support the ROPS with a suitable hoist or sling.



20099861 2

Next operation:
ROPS - Install ROLL - OVER PROTECTION BAR (E.34.A)

ROPS - Install ROLL - OVER PROTECTION BAR

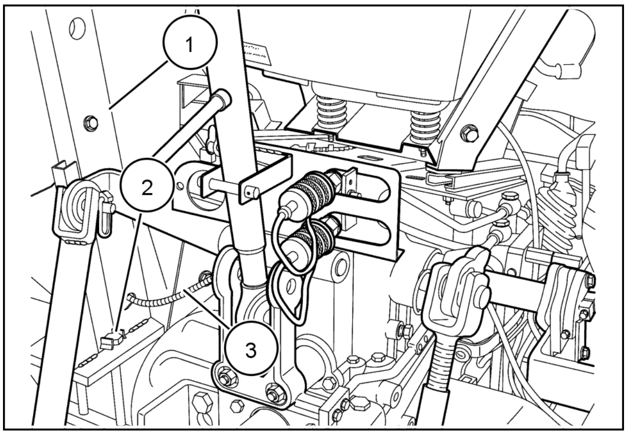
Prior operation:
ROPS - Remove ROLL-OVER PROTECTION BAR (E.34.A)

⚠ WARNING ⚠

Lift and handle all heavy components using lifting equipment of appropriate lifting capacity. Ensure that units or parts are supported by suitable slings or hooks. Ensure that no persons or pets are in the vicinity of the load to be lifted. Failure to comply could result in death or serious injury.

M1258

1. Position the ROPS, **(1)**, and insert all the mounting bolts. Secure the bolts with the belleville washers and nuts.
2. Tighten the mounting bolts, **(2)**, and nuts, in a cross pattern. After tightening all bolts, torque each M16 x 200 mm bolts to **240 N·m** (**177 lb ft**).
3. Install the fenders as described in **Protective shield - Install (E.20.A)**
4. Connect the light harness, **(3)**.
5. Check the work lamp and rear lights for proper operation.



20099861 1

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Workmaster 45
Workmaster 55

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SAFETY SECURITY ACCESSORIES Safety - 50.B

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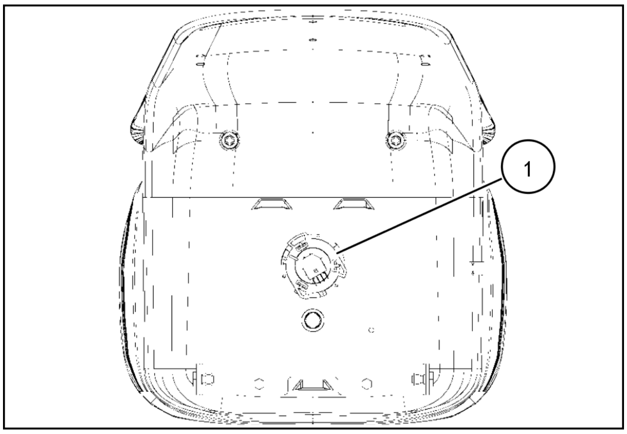
Install Operator safety module 10

Operator presence system (OPS) - Static description Seat safety switch

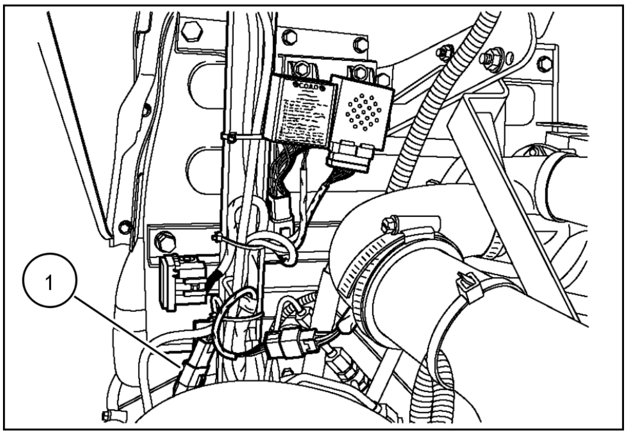
The seat safety switch, **(1)**, is a double pole, button type switch mounted to the bottom side of the seat pan. When the operator is not seated, the switch contacts are open and will not allow the tractor to start. When the operator is seated, the switch contacts are closed, allowing the tractor to start.



20097563 1

Operator presence system (OPS) - Static description Operator safety module

The operator safety module, **(1)**, is part of the tractor safe operation circuit. When the operator safety module is energized it allows the ground circuit for the control portion of the fuel shutoff solenoid relay to be completed. If current no longer flows to the operator safety module, the ground circuit for the relay becomes open. This causes the fuel shutoff solenoid relay to become non-energized. When the relay becomes non-energized, the current to the fuel shutoff solenoid is discontinued, stopping the tractor engine. Current is supplied to the operator safety module when the operator is seated, or when the PTO is disengaged and the parking brake is applied. The operator safety module, **(1)**, is located under the right side of the engine compartment in front of the tractor's firewall.

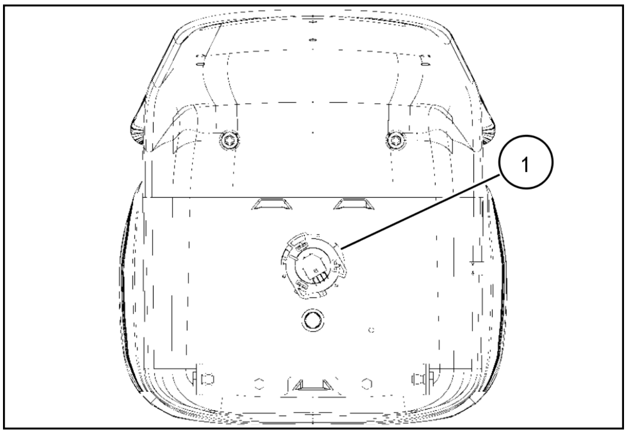


20099853 1

Operator presence system (OPS) - Remove Seat safety switch

NOTE: *The seat safety switch may be tested by removing the switch harness from the switch and placing ohmmeter test leads on the switch terminals. Push down on the middle of the seat to check for switch continuity However, it is recommended to remove the seat switch from the seat for testing.*

1. Tilt the seat forward to reveal the seat safety switch **(1)**.
2. Disconnect the seat switch harness from the switch.
3. Rotate the switch **(1)** counterclockwise to release the locking tabs and remove the switch from the seat.



20097563 1

Next operation:
Operator presence system (OPS) - Test Seat safety switch (E.50.B)

Operator presence system (OPS) - Test Seat safety switch

NOTE: *The seat safety switch may be tested by removing the switch harness from the switch and placing ohmmeter test leads on the switch terminals. Push down on the middle of the seat to check for switch continuity. However, it is recommended to remove the seat switch from the seat for testing; see:* ***Operator presence system (OPS) - Remove Seat safety switch (E.50.B)****.*

NOTE: *Use an ohmmeter to test both of the positions of the seat switch for electrical continuity.*

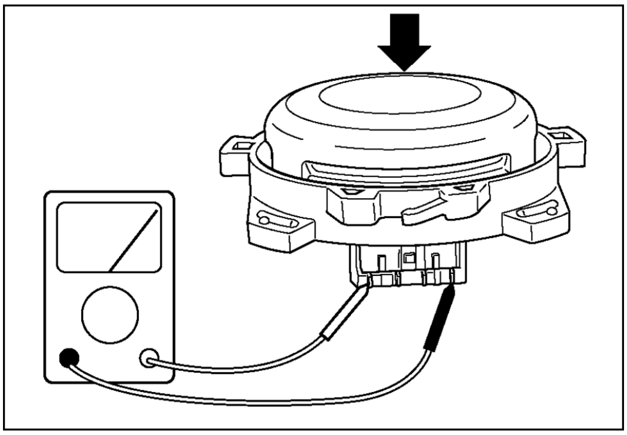
Extended Position

With the switch in the "extended" (OUT) position continuity should not exist between any of the four terminals. If continuity exists between any of the switch terminals while the switch is in the "extended" position, the switch is defective and needs to be replaced.

Retracted Position

With the switch in the "retracted" (IN) position, continuity should exist across the following terminals:

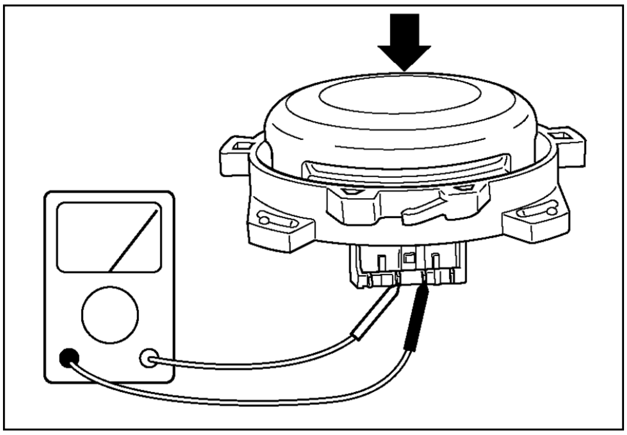
Check continuity between Terminals #1 and #4.



20099854 1

Check continuity between Terminals #2 and #3.

NOTE: *If continuity does not exist between the two sets of terminals while the switch is in the "retracted" position the switch is defective and needs to be replaced.*



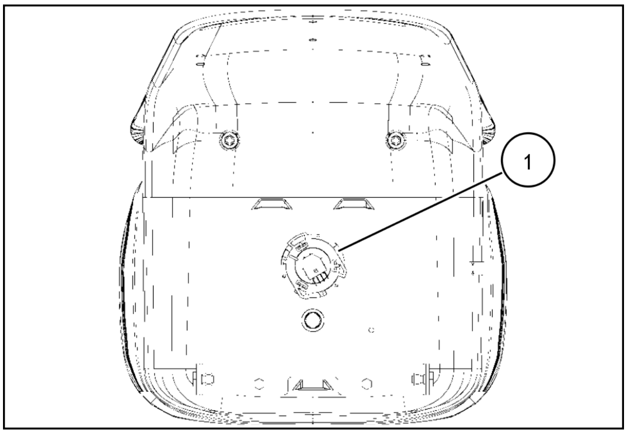
20099855 2

Next operation:
Operator presence system (OPS) - Install Seat safety switch (E.50.B)

Operator presence system (OPS) - Install Seat safety switch

Prior operation:
Operator presence system (OPS) - Test Seat safety switch (E.50.B)

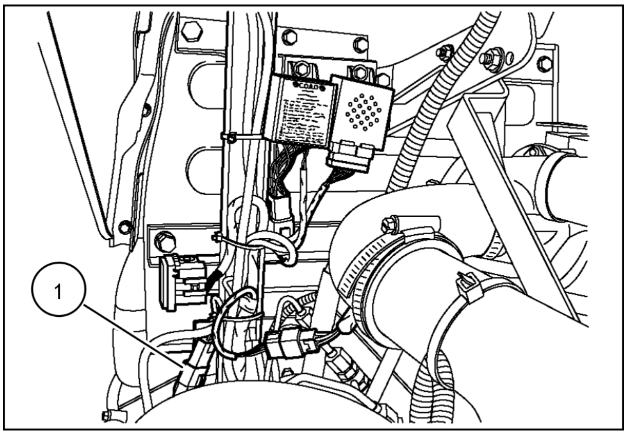
1. Tilt the seat forward to reveal the bottom of the seat **(1)**.
2. Rotate the switch **(1)** clockwise to retain the locking tabs.
3. Connect the seat switch harness to the switch.



20097563 1

Operator presence system (OPS) - Remove Operator safety module

1. Disconnect the negative (-) battery cable from the negative (-) battery terminal.
2. Remove the right-hand side cover to reveal the relay/ diode panel.
3. Release the locking tabs on the operator safety module **(1)**, to disconnect the module from the wire harness.



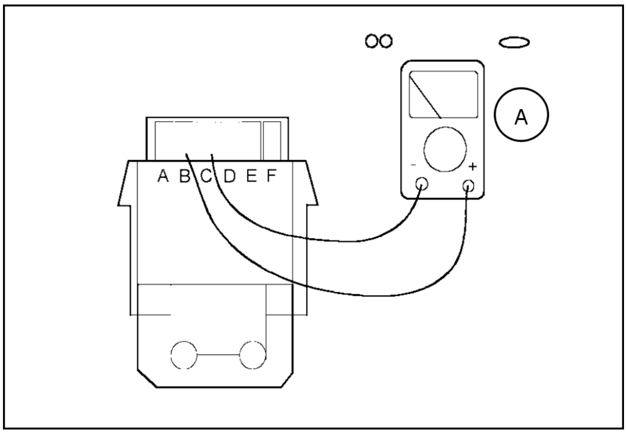
20099853 1

Next operation:
Operator presence system (OPS) - Test Operator safety module (E.50.B)

Operator presence system (OPS) - Test Operator safety module

Prior operation:
Operator presence system (OPS) - Remove Operator safety module (E.50.B)

1. Using an ohmmeter, touch the red, positive (+), test probe to module terminal "B". Touch the black, negative (−), ohmmeter test probe to diode terminal "C". Observe the ohmmeter.
2. The ohmmeter should show high resistance, indicating no continuity and that current is not flowing through the operator safety module. If there is continuity. Check to see that the test probes are on the correct terminals, and if they are, the operator safety module is defective and needs replaced.



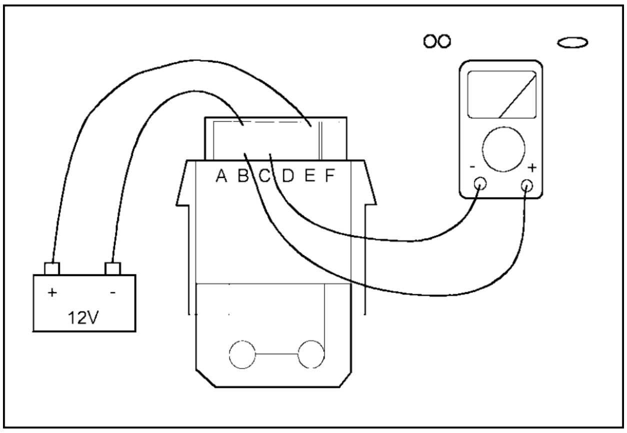
20097575 1

A - OHMMETER

3. If the previous test indicated the operator safety module was functioning properly, clamp the red, positive (+) , ohmmeter test probe to terminal "B" of the safety module and the black, negative (−) , test probe to terminal "C" of the Safety module.

NOTE: *Only apply battery current to the operator safety control module for 3 - 5 seconds or damage will occur.*

4. Connect a jumper wire from terminal "E" on the operator safety module to the positive (+) terminal of a **12 V** power supply.
5. Connect a jumper wire to terminal "B".
6. While observing the ohmmeter, touch the jumper wire to terminal "B" from the negative (-) terminal of the **12 V** power supply. There should be little or no resistance, indicating continuity. If the reading shows high resistance, the operator safety module is defective and needs replaced.



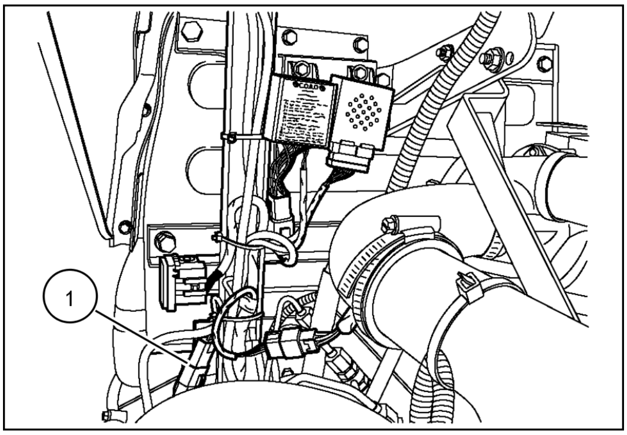
20097576 2

Next operation:
Operator presence system (OPS) - Install Operator safety module (E.50.B)

Operator presence system (OPS) - Install Operator safety module

Prior operation:
Operator presence system (OPS) - Test Operator safety module (E.50.B)

1. Connect the wire harness to the operator safety module, **(1)**.
2. Install the right-hand side cover.
3. Connect the negative (-) battery cable to the negative (-) battery terminal.



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